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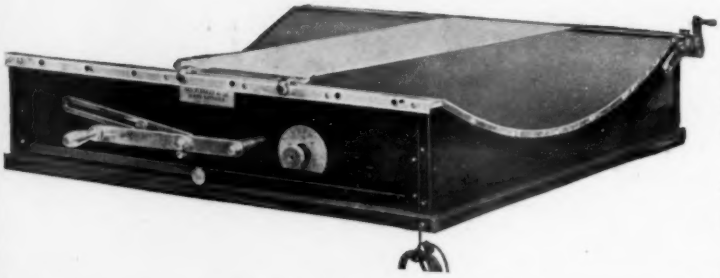

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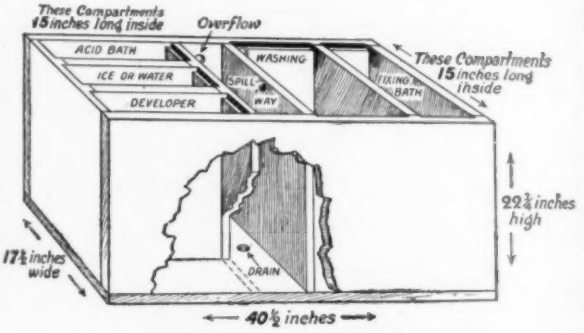

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THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

VOL. X JULY, 1923 No. 7

OBSERVATIONS ON OSTEITIS DEFORMANS

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From the *X*-Ray Laboratory of the Washington University School of Medicine

ST. LOUIS, MISSOURI

SINCE Paget's[1] original article on osteitis deformans appeared in 1877, the Index Medicus shows two hundred eighty-seven titles of articles dealing with that and related conditions. Despite this large amount of observation and study, the disease is still as obscure as to etiology and pathogenesis as it was in Paget's time. The fact that this obscurity exists seems to warrant report of the observations on 4 cases of unusual type along with a review of the literature. It is not proposed to go into a general discussion of all aspects of Paget's disease of bone, but to confine this paper to consideration of a limited number of its features. For additional information the reader is referred to Paget's publications and those of Gruner, Scrimger and Foster,[2] of Schirmer,[3] of Legros and Léri[4] and of Da Costa, Funk, Bergheim and Hawk.[5]

There are in the literature 213 cases of osteitis deformans, according to the figures of Leahy (1918)[6] to which number 33 subsequent ones can be added which do not include the writer's observation of 14 cases. These are chiefly from Europe and the United States. The disease has been reported from Australia[7, 8, 9, 10] and from Japan;[11] Hewitt[12] and Da Costa[13] have reported cases in negroes and the writer has witnessed an autopsy on an advanced case in a negress (unreported). Recently an article[14] has appeared describing the disease in three monkeys which was proved to be diagnostically correct from both the clinical and pathological points of view. The reports indicate a greater incidence in England and France than elsewhere in Europe, but it seems that this is due to the fact that greater attention has been given the disease in those countries. In the United States reports began to appear about the year 1890 and have been increasingly noted since. They are from all parts of the country. Clopton,[15] Hewitt[12] Deppe[16] and L. H. Hemplemann[17] have reported a total of 6 cases from St. Louis. The disease is commonly considered to be rare, but the facts hardly warrant this belief. Paget[18] at the time of his second communication had seen 23 cases and Locke[19] states that he has seen 50. There have been in the Washington University *x*-ray department 3 instances in 19,000 successive admissions; but the total of 14 cases in 163,148 admissions to both the Barnes Hospital and the Washington University Dispensary on the whole confirms the average of the incidences reported by Carman and Carrick[20] quoting statistics from the New Jefferson Hospital and the Johns Hopkins Hospital, also by LeWald (unpublished) of one in 11,000 admissions.

Osteitis deformans can be defined as a general disease of the skeleton, probably due to a constitutional state, as first suggested by Thibierge,[21] the chief manifestations of which are bony enlargement and subsequent deformity. The tendency of the disease is toward a slow, gradual involvement of the entire skeleton,

although it may remain confined to a single bone or portion thereof for an extended period. Many writers have described a mono-osteitic type of the disease, but it must be said that such cases were not under sufficiently prolonged observation to establish firmly the existence of such a type.

As to its symptoms, reports of the disease in the literature have an impressive similarity to one another and to Paget's account. In fact, after reading a series of clinical descriptions it would almost seem as if they might be interchangeable; which might also be said of the illustrations which accompany them. When fully developed the disease can be diagnosed at a glance, although it is well to bear in mind that senile and arthritic changes of the skeleton can closely simulate the deformity and carriage of Paget's disease, as has been pointed out by Mocquot and Moutier.[22] There has been no improvement of Paget's description of the disease in its late stage.

The obscurity as to the causation of osteitis deformans can be gauged by the diversity of theories to which it has given rise. A strong case can be made against any one of them. There is no reason to suppose that geographical, climatic or racial factors play any part in its production. The same is true as to sex, occupation, social conditions and status; the disease has been observed in the well-to-do and in the very poor. Its occurrence in different members of the same family is of such infrequency as to render the familial factor insignificant. The disease is one of the second half of life; it has, however, occurred sufficiently often in the young as to eliminate age as an essential cause of its production. Syphilis as a cause of the disease or the disease being a late manifestation of syphilis has had strong support in the past, following especially the teaching of Fournier[23] and Lannelongue.[24] When limited to a single bone, Paget's disease and syphilis can be strikingly alike. However, the unyielding progress of the former in the face of antiluetic treatment, and absence of other syphilitic manifestations in conjunction with a negative Wassermann reaction establish the different identities of the two conditions. Of 28 reported reactions in the literature up to June, 1921, 26 were negative and only 2 positive. Since that time, 33 reactions have been given, of which 9 were positive and 24 negative. Of the 14 cases we have observed, 1 was positive, 4 negative and for the remaining 9 no reactions have been reported. In this connection Deppe's[16] case of contracted syphilis after the development of osteitis deformans should be mentioned. Several writers have reported cases with syphilis. Chartier and Descamps[25] describe one with tabes, and in his second series Paget gives one with a definite syphilitic history.

Other infections and infectious diseases have not been demonstrated as playing a part in causation, the same being also true of intoxications.

Carcinoma appears to be no more frequent than in a like number of patients of the same age. Arthritis of any nature is a complication rather than a part of the picture of osteitis deformans. The frequency of mental enfeeblement and actual dementia is significant. Da Costa[13] calls attention to the very high incidence of sarcoma, and Williams[26] has written of the relationship between osteitis deformans and neoplastic disease.

What, if any, importance is to be attributed to the glands of internal secretion in the production of the disease must be deferred until their function and pathological states are better understood. Paget's disease and glandular disturbance have not been convincingly linked up.

Trauma does not seem to be of importance, although fracture is of frequent occurrence in those subject to this disease, and has been thought to be a direct cause in some instances. It appears more likely that fracture takes place because of the disease rather than the reverse. Léri and Legros[27] report a case where trauma was directly followed by development of the disease in a tibia.

Degenerative lesions of the spinal cord have been reported in association with Paget's disease, but they would seem to be part of the associated arteriosclerosis. No constant or important blood changes have been found. Da Costa et al.,[28] demonstrated in studies of metabolism a marked retention of calcium and magnesium with

increased elimination of sulphur in 3 cases. Pescarolo and Bertolotti[29] obtained essentially the same results from urinary studies.

The most striking association is that of circulatory disease, both arterial and cardiac. This incidence is far beyond that in a like number of patients of the same age, both in frequency and in degree. Attention to this has been called by many observers; reported cases of cranial involvement which are accompanied by photographs show tremendous enlargement of the temporal vessels. Especially in the cases of Da Costa,[28] Catola[30] and Ravenna[31] is this pointed out, the latter showing findings of low arterial tension. So great is the degree of enlargement of the vessels that the question arises as to the same process being the basis both of bone and arterial changes.

The onset of Paget's disease has never been described. When the condition is manifest it obviously has existed for some time. The progression of the disease varies in rapidity, in some cases being so slow that there is an apparent arrest; and its duration is always over a period of years. Its tendency is toward the ultimate symmetrical involvement of the entire skeleton. Acute development with rapid spread seems never to occur, and there certainly has been no reported case of recession. In its beginning the bones of the thigh, legs, pelvis and skull are first involved; though no portion of the skeleton can be considered exempt, yet the bones of the forearm, hands and feet are usually found uninvolved.

When once fully developed, the disease proceeds with increasing deformity and its resultant disability. There is rather more enfeeblement than the age of the subject would account for until death supervenes from intercurrent disease, usually cardiac. The condition itself neither causes death nor seems greatly to contribute to that outcome. Some cases go on to complete disability, while on the other hand, wide-spread involvement is not incompatible with both mental and physical activity.

The symptoms found in Paget's disease will vary with the stage of the disease and the parts involved. Often its discovery is accidental, the patient being unaware of the existence of any skeletal changes. What are commonly supposed to be the earliest symptoms—pain, weakness, slight disability, slight bony enlargement—are vague, uncertain, inconstant and often completely lacking; they are such as might accompany any bone or joint condition. When the bony changes are manifest, the disease can be considered as advanced, and if they are sufficiently pronounced, diagnostic.

As to bony enlargement and deformity, the latter is largely a result of the former. There has been much discussion as to the mechanism at work in the production of the deformity of osteitis deformans. The view most generally advanced is that it is produced as the result of weight-bearing by softened bone, though this does not explain the deformities of the skull or upper extremities. Paget himself suggested that the bones increased in length as well as in other dimensions and that the fixation of the extremities of these softened bones by the investing tissues produced the curvature. Clutton[32] clearly demonstrated increase of length in a humerus. At a much later date Scrimger et al.[2] considered that increase of length, fixation by soft tissues and malleability of bone work together to produce the deformity. This view appeals to the writer as being the true explanation of the occurrence, for the reason that the changes have a constancy never observed in any other deforming condition; and further, the bowing is always to the side opposite the greatest mass of soft tissue. The similarity between the illustrations of Paget's disease has been referred to, and it might be said that any two pagetics vary in their deformity only in degree.

Deformity of the skull which has been particularly studied by Léri[33] and Regnault[34] presents the same constancy as that of the trunk and limbs. Léri explains this as being brought about by the interplay of malleable bone, weight of head and the upward thrust of the spine. The writer would add as a determining agent, fixation of the base of the skull by the attached soft tissues. Involvement

of the bones of the extremities and trunk would produce no particularly unusual symptoms as compared with the skull. Here the possibilities of the development of peculiar symptoms are, through pressure on cranial nerves, almost endless. Léri has conclusively shown that narrowing of the openings of the skull is of almost constant occurrence. Schuller[35] mentions a case of the disease restricted to one temporal bone with ear symptoms, and the literature

FIG. 1. No. 8840. Osteitis fibrosa cystica. Showing enlargement, textural change, deformity. Contrast with changes of osteitis deformans and note strict diaphyseal location. This patient was under observation four years. An example of osteoplastic metastatic carcinoma is omitted for the reason that a suitable case for reproduction was not available.

records many instances of affections of the organs of special sense. In this connection it should be mentioned that the teeth are occasionally extruded when there is involvement of the alveolar processes. This with involvement of the palate bone can also greatly diminish the capacity of the oral cavity. Abbe[36] has written on the surgical aspect of this alveolar enlargement. One of the cases of Paget's second series[18] had a huskiness of the voice which the author attributed to the enlargement of the hyoid bone which was pronounced. The writer's third case had a trigeminal neuralgia, and in addition an uncertain history of nasal obstruction and dysphagia.

Before leaving the matter of special symptoms that might arise when Paget's disease involves the skull, it should be said that osteitis deformans of the skull merits the close attention of the rhinologist, ophthalmologist, otologist, neurologist and the oral surgeon.

Summarizing the symptoms of Paget's disease: they may be considered as almost wholly objective, and are only distinctive late in the affection, at which time they are unique.

From the foregoing it is clear that the diagnosis of Paget's disease must rest almost entirely on objective findings. There should be no difficulty in arriving at a correct diagnosis at the time when the patient presents himself, as usually this is at a late period in the disease and the characteristic objective findings are all present. Early cases of the disease, when encountered incidental to a roentgenological examination, present more difficulties. The writer's experience leads him to believe that the disease is never recognized as long as it remains localized or partially so. It certainly never is unless recourse is had to *x*-ray examination.

In the course of experimentation with the *x*-ray in 1896 by Levi and Londe[37] in Paris, a specimen of dried pagetic bone was used. It is of interest that the exposures were of ten-minute duration. Kienbock,[38] in 1902, claims a characteristic *x*-ray appearance for pagetic bone. The same conclusion was reached at about the same time by Béclère.[39] Practically all subsequent writers on the subject have referred to the *x*-ray appearance in this disease. It has been especially studied by Léri[33] whose work will be referred to again.

Radiographic findings in osteitis deformans may be said to consist, in the order of their importance, in changes in texture, size, form and outline of the involved bone. Of these, the most significant is the increase in bulk, which appears neither as a result of an internal expanding process, nor yet as an apposition or accretion of bone.

Texturally there is early a rarified condition (which at times borders on the cystic) manifested in the cortex of long bones. (See Figs. 1, 2, 3, 4.) For the homogeneous, smooth-textured, compact layer is substituted a wide-meshed, coarsely reticulated structure, in the interstices of which there is a softer tissue relatively deficient in calcium. A later appearance is that of a bone condensation which is irregular, occurring in patches and quite dense. Except as to the last, an appearance simulating this picture is occasionally observed beneath articular cartilage. It is extremely difficult to put into words the radiographic findings in pagetic bones, and no words are of themselves as descriptive as the *x*-ray negative. It must be borne in mind that what was said as to the characteristic findings of Paget's disease varying with the stage of development applies as well to radiographic as to clinical examinations.

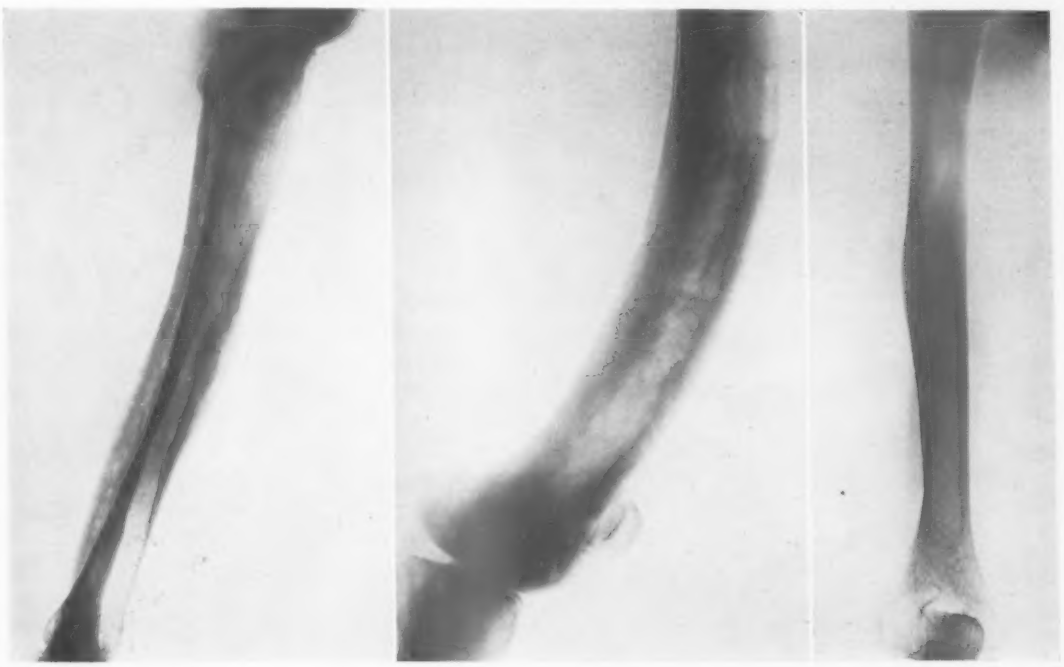

FIG. 2. FIG. 3. FIG. 4.

FIG. 2. No. 26993. Included to demonstrate early appearance of Paget's disease in tibia. Cortex rarefied, widened and encroaching on medullary cavity. Note that fibula is involved throughout.
FIG. 3. Femur of same patient as in Figure 2. Contrast with Figure 1. Note non-involvement of patella.
FIG. 4. Humerus of same patient as in Figure 2. Note early process in cortical bone on outer aspect at midpoint. Considered earliest manifestation of Paget's disease.

These two processes of rarefaction and condensation go on side by side, and the predominance of one or the other gives a rough indication of the stage of the disease; the former being the primary, the latter a secondary and apparently reparative process. Alterations of form are a constant late finding and are of sufficiently distinctive character as not to be confused with those of other states. The outline of pagetic bone is smooth and of even curvature radiographically, without either projections or superficial losses of substance.

Specifically, osteitis deformans is to be differentiated from any bone condition producing enlargement, deformity, rarefaction and condensation in varying degrees. These conditions are syphilis, tumor, chronic inflammatory states, true hypertrophic changes, osteitis fibrosa cystica, osteomalacia, and when restricted to the skull, hyperostosis cranii and leontiasis ossium. The writer has had no opportunity of observing either osteomalacia, hyperostosis cranii or leontiasis ossium. He would judge from the literature that it

is extremely doubtful whether hyperostosis cranii exists as a separate entity. Greater accuracy would seem to classify such cases as either osteitis deformans or leontiasis ossium. Between the last-named and Paget's disease the writer is of the opinion that a differentiation could always be made on the clinical findings. The distinctive point that observers of osteomalacia bring out is that there is no enlargement of bone in this condition and such deformities as occur are irregular, inconstant and tend to angulation. Circumscribed syphilitic involvement of bone is so evidently destructive in nature with loss of substance and accompanying repair, manifested as a sclerosis, that there is little likelihood of confusion with osteitis deformans. The diffuse form of syphilis as typified in the sabre shin has as its distinctive feature such evident condensation that its appearance is, in the majority of instances, characteristic. It is furthermore strikingly diaphyseal in location, while Paget's disease is not so limited.

In the skull, syphilis shows such a definite surrounding zone of reaction combined with such an obvious process of destruction and repair as to distinguish it clearly from osteitis deformans. Of neoplasm affecting bone, only those capable of producing ossification should cause confusion. These are the new growths originating in bone and metastatic osteoplastic carcinoma; the former produces enlargement either by an expanding process from within or as an external accretion to the bone, the finding of which differs from the even enlargement of Paget's. Osteoplastic carcinomatosis of bone does not show a symmetrical increase in size; such increase as does take place is usually asymmetrical and definitely the result of irregular deposition of newly-formed bone. In place of rarefaction there is usually a great increase of bone density.

FIG. 5. FIG. 6.

FIG. 5. Case I. Upper half of left femur and adjacent portion of pelvis, showing characteristic changes in both. Note deformity (below) of old fracture and fracture line above.
FIG. 6. Case I. Humerus showing characteristic bone change.

Diffuse involvement of the skeleton by metastatic soft tumors might produce a condition remotely resembling the rarefied stage of Paget's disease.

Chronic inflammatory states of bone should be readily differentiated because of the predominance of repair processes; and hence great sclerosis, irregularity of enlargement and outline, the presence of sequestra, and such deformity as may exist will hardly be of the even curvature of Paget's disease.

Osteitis fibrosa cystica should be distinguishable from Paget's disease by history and clinical findings. There is found a diaphyseal process of medullary origin. Hypertrophic states in bone are so frankly increase in size of normal tissue that they would present no difficulties.

A description of 4 selected cases that have come under the observation of the writer follows:

Case I. No. 6754. White, male, aged fifty-three. Nothing striking in history until the forty-ninth year when the shaft of the left femur was fractured in a fall. Prompt satisfactory union; six months later again fractured the same femur at a slightly higher level, again with good repair. *X*-ray examination at that time raised the question of the presence of sarcoma.

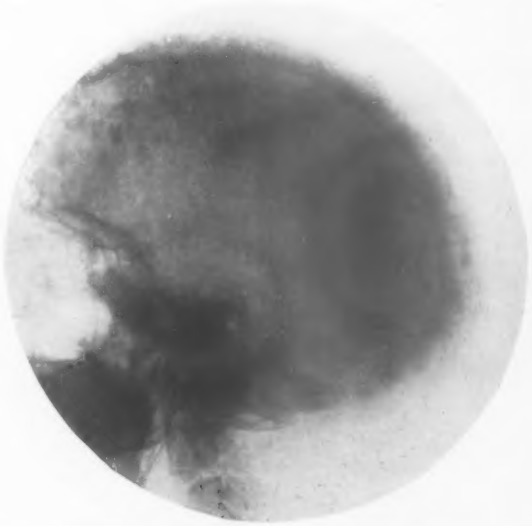

FIG. 7. Case I. View of skull showing typical involvement of Paget's disease.

FIG. 8. Case II. Photograph of left leg, showing forward and outward bowing.

FIG. 9. Case II. Roentgenogram of left leg.

Entered the Barnes Hospital Feb. 16, 1920, for study, having had the lower end of the right humerus fractured as the result of considerable violence. Examination revealed nothing bearing on the case except the fractured humerus and an enlarged left femur. No deformities noticed.

Laboratory examinations including Wassermann reaction were negative. The blood calcium was 13.4 mg. per 100 ml. of blood serum. *X*-ray examination showed the following: "Typical appearance of Paget's disease in the upper portion of the left humerus, lower portion of the right humerus, upper half of the left femur (See Figs. 5 and 6) left half of the ilium and sacrum and in the skull. The last is enormously increased in thickness throughout the calvarium. (See Fig. 7.) The outline of the inner and outer tables is entirely lost. The left femur shows unsymmetrical enlargement at the site of the fractures. The left humerus shows similar processes involving the cortical bone, as is observed in the tibia of the following case.

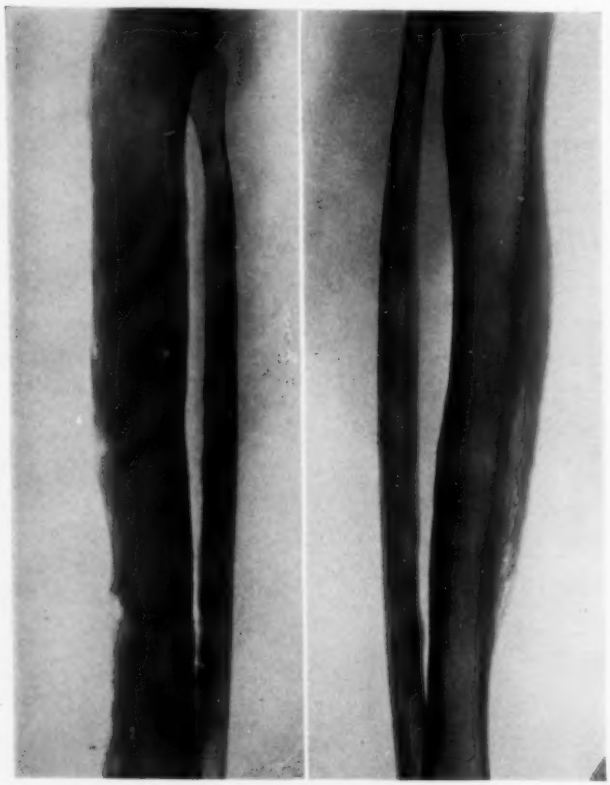

FIG. 10. FIG. 11.

FIG. 10. No. 10159. Changes produced by antecedent osteomyelitis and surgical operation. Introduced for contrast with Figure 9, Case II.

FIG. 11. No. 8192. Syphilitic osteitis. Introduced for contrast with Figure 9, Case II.

Case II. No. 6776. White, female, aged fifty-eight. History irrelevant to condition up to four years ago when she had an onset of a peculiar train of symptoms consisting of nervous tremors and pain over the left side of the body. These quite indefinite symptoms have continued and she has had much pain, with some enlargement of the left leg.

Examination reveals nothing striking except a spindle-shaped enlargement of the left tibia which is bowed out and forward; and evidence of a mild nephritis. There were no laboratory findings of moment and the Wassermann reaction was negative. The greatest circumference of either leg was:

rt. 27.3 cm. lt. 29.5 cm.

The real length of either lower extremity:

rt. 78.5 cm. lt. 79 cm.

X-ray examination of the left leg showed characteristic appearance of Paget's disease. (See Figs. 8 and 9.) The skeleton was elsewhere negative except for a slight projection from the shaft of the left humerus.

In the course of palpating the affected leg, it was remarked that it was strikingly warmer than its fellow. To determine whether this was a true, constant elevation and not simply a temporary phenomenon, a series of diurnal observations over a period of a week was made. Exact methods of measuring this rise in temperature were not available, so recourse was had to skin thermometers applied under like conditions on the two sides. These readings were made over both tibiae, where they were subcutaneous, and also over the thickest portion of each calf. Simultaneously the oral temperature was taken. The observations extended over a period of seven days and showed an average of 4°C. higher temperature over the affected than over the opposite leg,

the oral temperature remaining normal. To see what, if any, part the circulation played in the production of this phenomenon, observations[1] were made on the volume flow of blood to the limbs by the method of Hewlett and Van Zwaluwenburg.[40] Many observations were made on the four extremities, averaging as follows:

lt. leg (affected)	rt. leg (sound)
2.83	1.14
lt. arm	rt. arm
2.95	3.02

Cutaneous temperature of the lower extremities, taken simultaneously, gave the following results:

Tibia surface	lt. 34° C.	rt. 31.5° C.
Calf	28° C.	28.5° C.
Oral temperature	37° C.	

When this increase in surface temperature over the affected bone was noted the writer was unaware that this observation had previously been made. The literature reveals that this phenomenon has been recorded by several writers. In Paget's second publication he mentions it as occurring over the tibia in two of his cases. Before his time B. Schmidt[41] in 1874 records the occurrence of increased heat over the tibia in a condition which from his description was unquestionably osteitis deformans and to which he applied that designation. Pozzi[42] mentions a local elevation of temperature without fever in a case of Oliers. Von Kutscha[43] in 1906 records a similar finding. Chartier and Descamps[25] noted this occurrence over the tibia, right arm and right side. Bartlett,[44] 1909, also noted the phenomenon and stated his belief that it was an early finding, and that it was also found in Eades's case. Gaenslen,[45] 1914–15, noted an increase of temperature over an affected tibia and suggested a focal infection as a remote cause. Da Costa[13] in 1921 mentions that increase of surface temperature is an inconstant symptom of Paget's disease. Klippel and Pierre-Weil[46] are the only writers that have devoted particular attention to this symptom and they consider that it is due to a local increased thermogenesis, and not to an increased radiation, although they admit that their methods of investigation were crude and incapable scientifically of proving their contention. They were very clear that there was no evidence of local inflammatory process as ordinarily seen, nor was there local evidence of increased vascularity.

The one suitable case that has come under observation on whom a comparative study of a different condition could be made was No. 8192, a syphilitic with a concurrent tuberculosis. The Wassermann reaction was 100 per cent inhibition, substantiated unmistakably by clinical evidence of the disease. The radiographic examination revealed a typical sabre shin on one side only. (See Fig. 11.) Analogous temperature readings were made over both tibiae and were practically identical showing, however, the fluctuations of temperature which were evidently a part of his general febrile movement. Unfortunately the volume flow of blood could not be determined in this case.

Case III. No. 4669. White, female, aged fifty-eight. History unimportant until 1909, at which time, following the extraction of a left upper molar, pain began in the upper portion of the left side of the face. In 1912 had an operation for "removal of bones in the nose." The nose was treated subsequently over a period of four years because of obstructed breathing. Since 1916 has had frequent attacks of neuralgic pain over left side of face. During the past few months has had slight dysphagia. Entered hospital Oct., 1917 for tumefaction of left superior maxilla and neuralgia.

Physical examination shows prominence of the left side of the face which is tender. Teeth are widely spaced, the alveolar processes prominent and the upper incisors directed backward. There was an evident trigeminal neuralgia.

Gasserian operation done with resulting incomplete relief but great amelioration of neuralgic pain. At operation there was much difficulty encountered because of the great vascularity of the skull, which was increased in thickness.

X-ray examination revealed the following: There are no findings except in the

[1] I wish to acknowledge my indebtedness to Dr. W. S. Priest, late resident of Barnes Hospital, for making these observations.

skull and bones of the face. (See Figs. 12, 13 and 14.) There is thickening of the calvarium, chiefly through an increase into the calvarium. The left superior maxilla is enlarged and decreased in density and projects beyond the mandible.

FIG. 12. Case III. Photograph showing asymmetry of face as the result of enlargement of bones of left side of face.

FIG. 13. Case III. Showing enlargement of alveolar process of upper jaw and separation of teeth.

in width of the outer table. Beginning in the left vertical portion of the frontal bone, about 2 cm. above the orbital roofs

FIG. 14. Case III. Roentgenogram of skull, showing rarefied area in frontal bone, massive alveolar process of upper jaw, displacement of anterior upper teeth and their lack of bony investment.

and as far forward as the frontal sinus, there is a band of rarefaction extending backward to a point above the petrosal bone. It extends from the base well up

The upper central teeth are directed sharply backward and have little bony investment about their fangs anteriorly.

Examination of April, 1920, shows increase in size of the rarefied area previously noted and an operative defect. The maxillary changes are more pronounced than at the time of the previous examination.

The fourth history is included in this series as a case of Paget's disease diagnosed on *x*-ray evidence alone; such evidence being deemed conclusive enough to justify the diagnosis. A single lumbar vertebra (the third) appeared in the *x*-ray plate with a symmetrical enlargement and the textural changes which characterize Paget's disease, viz., a combination of rarefying and condensing osteitis proceeding simultaneously. (See Figs. 15 and 16.) Necessarily there can be no deformity except the enlargement. *X*-ray examination of the remainder of the skeleton showed it free from involvement.

Case IV. No.'86228. White, male, fifty-five years of age. Clinically the history shows nothing of moment to bear out the diagnosis. The patient presented himself at the dispensary because of pain in the back and along the course of the sciatic nerve. Physical examination was negative except

for a muscle spasm in the lumbar region. Wassermann reaction negative. This case

FIG. 15. Case IV. Roentgenogram of lumbar spine showing enlargement and textural change in third lumbar vertebra.

FIG. 16. Case IV. The same as Figure 15, retouched to bring out features mentioned.

is considered one of the early so-called mono-osteitic type.

Paget calls attention to the great vascularity of pagetic bone, as have many writers since. Several have observed the enlargement of temporal vessels in cases of skull involvement which they reported, especially Catola[30] and Pescarolo and Bertolotti.[29] The illustrations of their cases show a pronounced increase in size of the temporal vessels, and this is also observable in Da Costa's[13] latest case. Great vascularity was apparent at the time of operation on the writer's third case, as has been mentioned. Increased vascularity of bone in Paget's disease can be considered as established beyond doubt. It exceeds in degree that of some types of tumor. The significance of its occurrence is not apparent; it certainly exceeds increased vascularity observed in infectious states of bone. In fact, it is of such degree that the question arises as to its being the cause of the osteitic process. To the writer it seems that the process in the bone is one producing increased vascularity, but this in turn is hardly sufficient to explain the local increase in temperature.

The nature of this disease can be said to be at present entirely unknown. Paget,

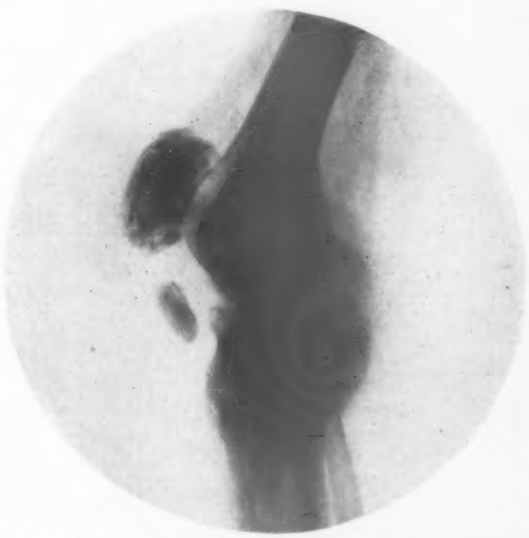

FIG. 17. No. 57919. Included to show patellar and tibial involvement. Loose fragment the result of antecedent fracture of patella. This history not included in report.

in discussing this point, states that it is neither of a hypertrophic nor neoplastic

nature, although it has some features of each. He concluded that it more closely resembled an inflammatory process. It is pertinent in this connection to call attention to the unique findings of Hudelo and Heitz,[47] in whose case the bones of the leg had fused into a homogeneous mass of pagetic bone.

Before closing the discussion of increased vascularity in Paget's disease, the evidence points to the former being sequential to the latter when the bone changes of hypertrophic pulmonary osteoarthropathy and those found in local circulatory obstruction are borne in mind. Some other factor than simple engorgement must come into play in the production of Paget's disease.

SUMMARY

1. Although Paget's disease is not common, it cannot be considered rare. In spite of the ratio of incidence reported by Carman and by LeWald, the probabilities are that if sufficient *x*-ray search were made, the disease would be more frequently discovered.

2. This disease gives a characteristic *x*-ray appearance and the diagnosis is justifiable on *x*-ray examination alone if such examination reveals in the order of their importance, textural changes of bone (a combination of rarefaction and condensation) and symmetrical increase in bulk and deformity.

3. From the standpoint of treatment it is useless to study Paget's disease at present. It should, however, be carefully investigated, for the reason that there might be uncovered a function of bone other than the rather passive ones of support and the housing of blood-forming organs. It is conceivable that aberrance of this possible function may produce the disease known as osteitis deformans.[1]

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[1] I wish to acknowledge my indebtedness to Dr. George Dock for the privilege of studying certain of these cases which were on his service at the Barnes Hospital

COMPLETE ANTERIOR DISLOCATION OF THE DISTAL EPIPHYSIS OF THE FEMUR*

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A REVIEW of the literature will show reports of numerous cases of dislocation of the distal epiphysis of the femur, with or without an accompanying fracture. It is also recognized that dislocation in the anterior direction is the most common. Notwithstanding the number of these cases reported, it is a condition not frequently seen and probably less often recognized by the average practitioner, since without *x*-ray examination its detection is difficult. Hence, in districts where this diagnostic aid is not available the true condition may easily be mistaken for a simple fracture of the lower end of the femur.

The importance of recognizing these cases lies, first, (in extreme cases) in the immediate danger to the patient; second, in the prognosis. The danger is caused by the compression of the popliteal vessels and the subsequent gangrene of the leg. Poland[1] refers to several cases with this unfortunate result, in which the true nature of the injury was not determined until the amputated extremity was dissected. The prognosis must be guarded since any injury to an epiphyseal line may destroy the center of growth, causing the bone thus affected, to be shorter than its fellow.

This epiphysis is the first to appear, being present "in utero" and demonstrable by the *x*-ray at birth. It is also the largest one in the body, and the forces exerted upon it, due to the arrangement of the muscles and ligaments attached thereto, render it the more liable to dislocation. Its superior surface resembles a shallow saucer, and has an anterior lip that extends upward a short distance on the diaphysis. It is firmly attached to the tibia by the crucial and lateral ligaments of the knee-joint, and by the gastrocnemius and popliteus muscles.

The gastrocnemius arises mostly from the posterior surface of the condyles of the femur, only a few fibers coming from the diaphysis. The origin of the popliteus is the outer surface of the external condyle, posterior to its center. The plantaris sometimes has a few fibers of origin from the posterior surface of the condyles. The internal lateral ligament, together with the tendons of insertion of the internal hamstring muscles, extends from the inner surface of the internal condyle, posterior to its center, to the inner and anterior part of the tibia, just below its upper border.

With this arrangement it is evident that the tendency of both the ligaments and the muscles is to push the epiphysis forward, once its union with the diaphysis has been disturbed. It is also easy to understand how the tibia may act as a powerful lever to pry it loose.

Etiology. Age: This condition may occur at any time before ossification of the femur is complete (this is usually about the twenty-third to the twenty-fifth year). Truesdell[2] reported a case caused at birth by breech extraction, and Poland[1] mentions a case found in a fetus. The greater number occur between the tenth and twentieth years, due to greater and more violent activity during this period.

Sex: Slightly more common in males because of their rougher sports.

Trauma: There is a difference of opinion as to whether direct or indirect violence is the more common cause, but the evidence, seems to be slightly in favor of the latter. Any violence applied to the thigh, while the leg is held in a fixed position (or vice versa) may produce this dislocation. Probably one of the most frequent causes is a fall with the foot held fixed and elevated. Thus a fall from a chair, with the foot held in the rungs, or from a wheel with the ankle caught in the spokes, is an almost classical cause. Cases are reported in which the only trauma was an unexpected step downward. The traction and manipulation used in setting a dislocated hip, or the traction applied in the treatment of a

* Paper submitted with application for membership in THE AMERICAN ROENTGEN RAY SOCIETY, 1921.

[1] Poland, John. Traumatic Separation of the Epiphyses. London, 1898.

[2] Truesdell, Edward D. Birth Fractures and Epiphyseal Dislocations. New York, 1917.

tubercular hip have been known to cause the condition.

Predisposing factors: Any disease affecting the growth or development of the bones.

The following case is so typical in many respects that it seems to merit reporting:

FIG. 1. Lateral (before reduction).

FIG. 2. Anteroposterior (before reduction).

Female, aged thirteen. Well developed and nourished; previous and family history indicate no predisposing diseases. Patient was climbing out of a farm wagon, her right foot placed between the spokes of the wheel, near the hub. She lost her balance and fell backward, striking the ground, but her foot remained wedged between the spokes, with the knee apparently flexed.

After the foot had been disengaged from the wheel, it was found that she could not extend the leg, and on physical examination a large, hard protuberance was seen on the anterior surface of the thigh, at the knee. Under anesthesia the leg was extended and a pillow splint applied. In this position the same protuberance was noted. The following morning the leg was swollen and slightly cyanotic, but otherwise there was no change in the appearance.

X-Ray Examination. Lateral view: The distal end of the diaphysis was displaced backward, its anterior border being almost on a line with the posterior border of the tibia, and its posterior border directly subcutaneous. Its lower border was irregular and rough. The condyles were seen, lying between the patella and the diaphysis; their inferior borders directed anteriorly, their posterior borders directed downward; their anteroposterior axis parallel with the vertical axis of the shaft.

Anteroposterior view: But little information could be gained from this position,

except that the condyles could not be oriented, and that the diaphysis ended very abruptly in a roughened line, having a shallow notch in its center. A large, roughly circular shadow was seen covering the lower four inches of the diaphysis, and overlapping both sides of it.

The patient was again given an anesthetic; the leg was flexed and traction was applied to it; pressure in the direction of the foot was exerted on the epiphysis, which was felt to return to its proper position in relation to the diaphysis; the leg was then extended and a cast applied.

Subsequent *x*-ray examination showed the reduction to be complete. The recovery was uneventful.

Unsuccessful efforts have been made to have the patient returned for further examination to determine if there is any difference in the length of the thighs.

SECONDARY SIGNS OF GALL-BLADDER PATHOLOGY*

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DURING the last few months it has been called to our attention that in some of the leading hospitals of this country the *x*-ray is not looked upon with favor as an aid in the diagnosis of gall-bladder disease. Even within a few weeks a patient was referred to our office with the story that he had been recently *x*-rayed in a neighboring institution for gall-bladder trouble. His examination proved negative, but he was informed by one of the staff that the evidence was practically worthless, as in their experience the *x*-ray was of help in less than 2 per cent of their gall-bladder cases. This institution seems to lack nothing in the way of material and equipment, and the personnel of its staff consists of leaders in the medical world.

Observing this atmosphere of doubt and skepticism emanating from the Roentgen Department of a great teaching hospital, we naturally have become somewhat disturbed.

We began to inquire of ourselves, "Can it be, after these years of apparent greater or less success in using the *x*-ray for the diagnosis of gall-bladder disease, that all this time we have been mistaken in our conclusions, that we unwittingly have been fooling not only the patients and our consultants, but also ourselves?" With such an array of medical talent apparently diametrically opposed to one's firm belief in regard to the *x*-ray, it would behoove an ordinary roentgenologist to take a very exhaustive account of stock, carefully distinguishing between fact and fancy, before attempting to override this solid barrier of unbelief.

Is it possible to harmonize satisfactorily or explain these two extreme points of view? Can our claims for the *x*-ray in gall-bladder work stand the test of scientific investigation, or are they built on shifting sand and ready to collapse under the slightest stress?

Ten years' experience in the search for the elusive gall-stone has shown not only some vulnerable points in our own armor, but also some weaknesses in the logic of our skeptical friends. I want briefly to discuss some of these lessons which experience has taught us, with the hope that this difference of opinion can be shown to be more apparent than real.

First, let us consider the matter of statistics. Figures themselves do not lie, but certain use of figures may sometimes give a false impression and render the writer justly liable to adverse criticism. Correct conclusions can never be drawn from premises which are false or incomplete. Gall-bladder statistics are usually derived from premises which of necessity are incomplete, and for this reason are not only worthless, but may be almost vicious, in that they give a false sense of security. This fact has long been appreciated by the great majority, but unfortunately,

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even today we read of men attempting to prove the success of their gall-bladder work by quoting various high percentages of correct diagnoses.

The only cases in which one's gall-bladder diagnoses can be checked up are those which come to operation. Now, it requires no great stretch of the imagination to appreciate that, in any condition serious enough to warrant surgical treatment, the symptoms are going to be fairly definite and the local condition sufficiently advanced to make comparatively easy both correct clinical and *x*-ray diagnoses. It is evident then, that diagnostic results computed on operated cases alone will have an abnormally low percentage of errors.

Furthermore, these operated cases form a comparatively small part of all those coming for gall-bladder examinations. As for that great number of cases in which the clinical picture is doubtful, which are not ill enough to require surgery, and in which the *x*-ray might be of the greatest value, in none of these can the correctness of the *x*-ray be confirmed. Not infrequently, the high percentages based on operated cases are wrongly applied to this great mass of unproven cases.

Another source of possible statistical misinformation is the not uncommon habit of including in one's figures what are termed correct—"negative" opinions. Here again the law of chances helps to boost the percentages of what seem to be correct *x*-ray diagnoses. For example, some men routinely examine the gall-bladder area in all cases coming for a gastrointestinal examination. In the great majority of cases, for example, those showing a chronic appendix, intestinal cancer, duodenal ulcer, etc., the gall-bladder area will be reported as negative. Many of these patients come to operation and after the appendix or ulcer has been removed the surgeon examines the gall-bladder and reports to the roentgenologist that it was normal. That case is immediately listed as a correct *x*-ray diagnosis of the condition of the gall-bladder. Theoretically, this may be an honest procedure. Practically, however, it is very misleading as far as giving any true indication of the real value of the *x*-ray in diagnosing gall-bladder disease is concerned. In other words, in this class of cases, the roentgenologist does not need to expose even one film. If he simply will pass a negative opinion as to the gall-bladder, the percentage of correct guesses will be very nearly 100.

Furthermore, the roentgenologist may be greatly assisted in obtaining a high percentage of positive diagnoses of gall-bladder pathology, if he has a careful and persistent pathologist. I think it is worth considering that the same may be true of the gall-bladder that is frequently stated of the appendix: "No appendix is ever normal in adults over twenty-three years of age." If your pathologist will hunt long and carefully enough, he is likely to find some slight evidence of chronic inflammatory changes in every adult gall-bladder. Of course, this change may have nothing to do with the patient's symptoms, but nevertheless it saves the roentgenologist from an error.

In addition to the fallacy of statistics there is another habit which may be legitimately questioned. It is not impossible that, in interpreting gall-bladder films, the roentgenologist may be unduly influenced by the clinical evidence.

If a jaundiced woman of middle age comes for examination with pain under the right costal border radiating to the right shoulder, it is not unreasonable to expect that the roentgenologist will search a little harder or use his imagination a little more in seeking gall-bladder evidence in this type of patient, than in the case of a young man who presents himself for a diagnosis, complaining of distress in the median line two hours after eating, with a story of vomiting blood.

I think it is fair to admit that not infrequently a high percentage of correct diagnoses are claimed for the *x*-ray when as a matter of fact, the roentgenologist is enough of a clinician to be a very good "guesser" when it comes to reading the *x*-ray films.

Let me suggest, therefore, in making claims for the value of the *x*-ray in gall-bladder work, that we clearly distinguish between clinical and *x*-ray evidence, putting the credit for the diagnosis where it belongs.

Again, in discussing from time to time with various roentgenologists the reasons for their apparent lack of success in this line of work, I have observed that the most frequent cause of failure seems to lie in a lack of appreciation of the relative value of the different classes of *x*-ray evidence of gall-bladder disease.

We have been accustomed to divide *x*-ray evidence of gall-bladder pathology into two groups: direct and indirect. In the class of direct evidence we put the demonstrable stones and the visible gall-bladders. In the class of indirect or secondary evidence are put the demonstrable changes produced in other organs by gall-bladder disease.

I wish to emphasize most strongly that of these two classes, the class of indirect or secondary evidence is by far the more important in the establishing of an *x*-ray diagnosis of gall-bladder pathology. I feel that probably two thirds of our diagnoses are based solely on this class of indirect evidence. I also believe the converse is true: that probably less than a third of all cases of gall-bladder pathology will show definite direct evidence, such as gall-stones or a visible gall-bladder.

It is evident, therefore, that without an intelligent comprehension of what this secondary evidence is and an appreciation of its value, one cannot hope to find the *x*-ray of help except in a comparatively small percentage of the gall-bladder cases.

I will not attempt at this time to describe in detail the various types of secondary evidence, but will simply enumerate the more common phases.

1. The first group of indirect evidence includes the pressure deformities. Due perhaps to increased internal tension or to a thickening of its wall, the gall-bladder may produce unusual pressure on some of the adjacent organs. The duodenum is most frequently affected. The typical curve of the gall-bladder may be seen on the external surface of the duodenum, or occasionally on its superior surface, the latter best observed in the lateral view. This pressure from above frequently produces a characteristic flattening of the cap almost pathognomonic of gall-bladder disease. The antrum of the stomach, particularly with gall-bladders which are enlarged, may also show characteristic pressure deformities.

With considerably enlarged bladders, as in cases of hydrops, one may find the effects of pressure on the hepatic flexure or proximal transverse colon.

2. Another group of secondary evidence consists of those changes due to adhesions. This group may be divided into: *fixation* of adjacent organs by adhesions, and deformities in outline of adjacent organs from adhesions. In the group of fixation due to adhesions, the fluoroscope as well as the plates is of particular advantage.

The stomach and the first portion of the duodenum may be abnormally fixed over to the right side. The second portion of the duodenum, which usually lies parallel to the long axis of the body, may be displaced in varying degrees to the right, in some cases lying almost horizontal along the under surface of the liver, or again appearing to hang as a festoon outlining the lower pole of the gall-bladder.

The hepatic flexure and proximal transverse colon occasionally show evidence of fixation due to gall-bladder pathology. The proximal transverse colon may be angulated and displaced upwards, a condition occasionally termed as a pseudo-hepatic flexure.

The first portion of the duodenum may show an *irregular outline* due to deforming adhesions. The duodenum may be constructed as by a single band, or present a serrated edge as though an entire surface were glued or adherent to the gall-bladder. The stomach may show various types of adhesion deformities, all of which differ from the deformities due to gastric lesions.

The colon occasionally shows deformities characteristic of gall-bladder adhesions, the most common of which is a tab-like projection pointing upward and inward from the superior surface of the proximal transverse colon.

3. In the study of the stomach and duodenum for typical gall-bladder spasm, the fluoroscope is again of value. I believe there is room for considerable advance in this particular field of gastric reflex. It is frequently stated by clinicians that a diseased gall-bladder is probably the most

frequent cause of reflex gastric symptoms. It is, therefore, reasonable to expect some type of gastric spasm more or less characteristic of gall-bladder disease. We, as well as others, have observed that gall-bladder disease seems not infrequently to be associated with a rather extensive tonic contraction of the pyloric half or third of the stomach. When this type of spasm is observed persisting in several films or the fluoroscope, one will not go far wrong in immediately suspecting some type of gall-bladder pathology.

4. Lastly, the ampulla of Vater, when made visible by the retention of barium, in our experience has always been associated with some type of past or present gall-bladder disease. At least, this holds true in all our operated cases.

May I emphasize the point that much of this indirect evidence consists of very *slight* variations from the normal, and unless the roentgenologist through experience becomes familiar with these changes, they often will be entirely overlooked.

Direct evidence when present is, of course, the most dependable for making a positive *x*-ray diagnosis. Unfortunately, however, this type of evidence seems to be found only in a minority of gall-bladder cases. I will not attempt a discussion of gall-stones, but in considering the visible gall-bladder there are one or two points where mistakes in interpretation are commonly made.

1. Not infrequently, a food-filled antrum of the stomach will cause a shadow at times simulating very closely a gall-bladder shadow.

Such a shadow, however, may be differentiated from a true gall-bladder, first by the fact that it is inconstant. Peristaltic waves may alter its shape from time to time. If a second examination is made, taking precaution to have the stomach empty, this shadow will not be found. Furthermore, if the patient is given the barium meal, the clearly defined antrum will be found to correspond exactly with this suspicious shadow. Finally, in cases where the shadow is due to stomach or duodenum, one will usually find a definite line or margin between this shadow and the edge of the liver, whereas with a shadow due to the gall-bladder, we find it apparently fused and a part of the liver shadow.

2. An unusually shaped or placed kidney, or a kidney overlaid by a gas-filled colon may at times simulate a gall-bladder shadow. Precautions should always be taken to identify the right kidney, before designating a suspicious shadow as due to gall-bladder.

3. An unusually shaped edge of the liver may be confused with a gall-bladder. The presence of a Riedel's lobe or an unusually prominent fissure may be the source of confusion.

Again, one finds erroneous interpretations of the ampulla of Vater. One must remember that the ampulla is found on the inner side and close to the second portion of the duodenum, about at the junction of the upper and middle thirds. While it may vary somewhat in size, it is usually smaller than a pea. Congenital diverticula are not uncommon in this region, and should not be confused with a possible ampulla. These congenital diverticula may occur in any portion of the duodenum and may project from any surface. They are usually larger in area than the shadows produced by barium in the ampulla.

In addition to these chances for error in interpretation which can account for some poor results in gall-bladder diagnosis, we must also consider how far faulty technique is to blame for some of our failures.

While the fluoroscope has a very definite place in gall-bladder work and is perhaps indispensable for demonstrating certain types of secondary evidence, still, for consistently successful results, it is of prime and fundamental importance that the radiographic method be employed. Those who habitually use the screen for gastrointestinal diagnosis, perhaps taking an occasional routine film, are at once doomed to failure, if they apply this method to their gall-bladder work.

Of necessity, the fluoroscopic method has to be employed in many of our large hospitals, which accounts, to my mind, for the general lack of enthusiasm with which this work has been taken up in many large institutions.

A persistent use of films with intensifying screens and possibly the Bucky diaphragm is essential for any sort of a demonstration of direct gall-bladder evidence. Furthermore, a barium meal with practically a complete gastrointestinal examination is required to bring out adequately the secondary evidence. And as we have tried to show you, *without* this secondary evidence, the *x*-ray will be of value in only a very small percentage of our gall-bladder cases.

Again, the patient must appear for examination with the gastrointestinal tract empty. Therefore, those who use the double-meal method, seeing the patient for the first time several hours after the barium meal, are at once precluded from successfully using the *x*-ray for gall-bladder diagnoses.

In conclusion, may I remind you that I have attempted to discuss very superficially some of the possible causes of the wide difference of opinion which still seems to exist in regard to this gall-bladder work. I have tried to show you wherein some of us may have been over-enthusiastic in our claims and perhaps have based our conclusions at times on rather weak premises. On the other hand, I have tried to explain why some have failed of success, enumerating some of the common pitfalls which spell defeat in this line of work.

May I assure you that there is no doubt in my mind but what there is, somewhere between the two extremes, a safe and sane ground where honest and careful roentgenologists may successfully employ the *x*-ray in the study of gall-bladder disease, both with satisfaction to their consultants and profit to their patients.

DISCUSSION

DR. COLE. Dr. Leonard has just given us what seems to be a fair analysis of the value of gall-bladder diagnosis. Having been trained in the office of one considered by some to be over-enthusiastic, it seems to me that he has given an unusually well-balanced opinion of the value of this method of diagnosis.

We can stay at home, we can work hard, and we can see cases and pathology there, but it is only at these meetings that men make up their minds to do things which they have not done before, making radical changes.

In the very first communication which I gave on this subject I stated that we should consider the indirect or secondary evidence first because we believe it of greater value than the direct evidence. In a case that presented itself for a routine examination of the gastrointestinal tract, including the gall-bladder which came with obscure symptoms, if the roentgenograms showed distinctly a group of gall-stones, and there was no indirect evidence of those gall-stones or gall-bladder pathology, I would say that that evidence, that is, the gall-stones, was of far less clinical and surgical significance than another group of cases where there was characteristic indirect evidence, but no stones shown. I will go so far as to say that I believe that in those cases where gall-stones are shown distinctly, where there is no indirect evidence of adhesions, there is not sufficient roentgenological evidence upon which to base a diagnosis of pathological gall-bladder which has surgical significance.

Therefore, it is at such meetings as this that we make up our minds to do things. So far as I am concerned I am through for good and all examining patients solely for direct evidence of gall-stones. If they want an *x*-ray examination solely for the diagnosis of stones, and do not want a complete gastrointestinal examination, they can go to other roentgenologists, but I am through.

We have all seen time and again this pressure deformity on the cap where there is indirect evidence of adhesions which hold the cap in place with the patient in various postures. What Dr. Leonard is talking about is that pressure without adhesions, that deformity of the cap and of the descending duodenum without evidence of any other secondary adhesions. If time proves that this is a valuable and accurate method of basing a diagnosis of pathological gall-bladder, then I say that something new and valuable has been presented at this meeting by one of our own members.

There are, however, pitfalls, in that there are other things in the right hypochondrium which will give that pressure, and these must be differentiated from the gall-bladder. One is the caudate lobe. Pressure of that lobe on the cap might lead to error.

There is only one other point I would like to make about this indirect evidence. If all deformities of the cap which are not ulcers were due to gall-bladder adhesions, the going would be a path of roses, but in many instances we have a veil or membrane, which I have described at previous meetings, which is the "fly in the ointment." You must attempt to differentiate those that are of gall-bladder origin from the congenital veils or membranes.

It is perfectly easy for the surgeon, if he is familiar with the surgical appearance of the veil, to go in there and find it. If the surgeon is intent on its being of gall-bladder origin, he takes the gall-bladder out and sends it to a pathologist; and there is not one pathologist in a hundred who depends for his salary on the hospital who will not report it as gall-bladder pathology.

DR. BAETJER. I think Dr. Leonard's paper has been a most constructive one for presentation to the Society. The question emphasized by Drs. Cole and Leonard, of indirect evidence of gall-lbadder infection, that is, the relation of the gastrointestinal tract to the gall-bladder, is extremely important. Up to the present time the whole question has seemed to center about gall-stones, and undue importance was attached to their detection. A great proportion of our diagnosis of gall-bladder infections rested upon the detection of gall-stones. Dr. Leonard has pointed out that the finding of deformity and adhesions of the duodenum is really of more importance than the finding of gall-stones. It seems to me that this is a most logical conclusion to arrive at, and that it will, once and for all, reduce the great importance which heretofore has been attached to the detection of gall-stones. It also seems to me that we will really be giving more aid to the surgeon by telling him of the presence or absence of adhesions. In the same way, after an operation, the question of adhesions is a very important one, and there again, we will be able to render material assistance. It seems to me that we have at last arrived at the true basis for the study of diseases of the gall-bladder.

DR. LEONARD (closing discussion). This is not a reversal of form, as Dr. Baetjer said. It is simply natural progress. We first looked for gall-stones and then we looked for gall-bladder. Now we are looking for secondary changes. The future advance of this work is going to be on secondary changes.

The matter of differentiating the pressure from a gall-bladder and from other things is a question we will not take time to discuss. It is going to be possible to make satisfactory differential diagnoses of these pressure and adhesion deformities.

The matter of an ambitious, enthusiastic pathologist is an important thing. The statement that every person over twenty-three has an abnormal appendix is I think, more or less true of the gall-bladder also.

THE ROENTGENOGRAPHIC STUDY OF THE MUCOSA IN NORMAL AND PATHOLOGICAL STATES

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THE Solon advises: "A book should not be judged by its cover." To decided advantage may this dictum be heeded by the roentgenologist, who, to date, in his study of disease of the alimentary tract, has been content to base his conclusions on the changes of contour, consequent to pathological changes of the hollow viscera. These changes are revealed on the mucosa before the deformity of its outline is produced. Therefore, demonstration of the mucosa will offer much valuable information not to be obtained by the contour method, and at an earlier date.

The prime object of this work was the demonstration of the gastric rugae, as an indication of gastritis; this possibility having suggested itself after observing the wide variation in the size and character of these folds, particularly during fluoroscopy. Later, it seemed that such study of the mucosa offered possibilities in demonstrating the earlier changes of the organic lesion and in the more detailed study of those conditions already recognized by the present day routine procedures.

In this work the condition of the gastric mucosa has been studied chiefly through consideration of the rugae. Usually, these folds of mucous membrane arise in the cardia and extend downward towards the pylorus, parallel to the axis of the stomach (Fig. 1); frequently those near the greater curvature are oblique and may cross from the posterior to the anterior wall (Fig. 2). Near the greater curvature also, there is frequently seen a fragmentation of the rugae (Fig. 3), this consisting of a division of the folds into

portions, an inch or more in length, which may be very tortuous (Fig. 4). Then

FIG. 1. Roentgenogram of mucosa, demonstrating the normal rugae formation of the posterior wall.

FIG. 2. Roentgenogram of mucosa, demonstrating normal rugae extending obliquely across the posterior wall of the stomach.

too, one fold from the cardia may divide or there may be a fusion of several which have their origin above. Frequently, however, there is tendency towards an orderly arrangement from the cardia towards the pylorus (Fig. 5). The rugae may be equally well formed on the anterior and posterior walls, though frequently those of the former are not nearly as well marked. There appears no common arrangement of these mucosal folds, and a wide variation may be noted in different individuals. Their formation is largely dependent upon the muscularis mucosa and the degree of gastric tonus. These observations tend to prove that no change (active or passive) of the position or shape of the rugae occurs while the stomach is in a non-functioning state (Figs. 6 and 7).

In the anatomical specimen, tension tends to obliterate these folds, but on its release they resume their appearance and their former relation. This is due to the fact that the rugae are held in formation by loose connective tissue which permits of their disappearance under pressure. Consequently, this examination is best made on the non-distended stomach.

In our work, the rugae of the posterior

FIG. 3. Roentgenogram of normal mucosa, with irregular rugae formation at greater curvature.

wall have been studied more completely, as this region is much more frequently the site of abnormalities. As noted roentgenographically, the number of rugae vary

with the type of stomach. In the hypotonic type there may be fewer in the vertical than in the horizontal arm, while in the hypertonic variety the number of folds is decreased from the cardia to the pylorus. The orthotonic stomach usually contains about the same number, throughout its length. The rugae, considered normal, as measured on the roentgenogram, (22 in. target film distance) are 2–4 mm. in width. It is to be understood that the foregoing conclusions are the result of roentgenographic demonstration of the mucosa in the living subject; unfortunately, these cannot be compared directly with those noted during autopsy or operation, as the conditions at such times are totally different.

CONDITIONS PRODUCING VARIATION OF RUGAE

The rugae vary according to the tone of the stomach. When the tone is increased, the surface area of the gastric mucosa is decreased, with the result that its folds are thrown closer together and become more prominent; but when the organ is atonic, the surface area is increased and the mucosa put on stretch to such an extent that the rugae are obliterated.

In hypertrophic gastritis there occurs a cellular infiltration of the mucosa with resultant thickening of this coat; and in the submucosa there occurs a connective tissue hyperplasia. As a result, the rugae are

FIG. 4. Roentgenogram of anatomical specimen of stomach, after incision along lesser curvature. (1) Pars cardia. (2) Esophagus. (3–4) Lesser curvature. (5) Pyloric region. Rugae well formed on anterior and posterior walls, tortuous in region of greater curvature.

enlarged, and of somewhat irregular formation, and tend to resist obliteration.

The atrophic type of gastritis is associated with a marked thinning of the mucosa and all coats of the stomach wall, consequently is characterized by an absence of rugae formation.

Accompanying the diffuse infiltrative carcinoma, there is a decrease in size of the stomach and an atrophy of the mucosa with disappearance of its folds. Concerning the condition of the mucosa with carcinoma of the stomach, Ewing, in his excellent work "Neoplastic Diseases," states: "A relatively intact mucosa often persists in cancer following ulcer. . . . In some cases an adenocarcinoma is associated with general hypertrophic gastritis. Chronic productive gastritis with atrophy is the most frequent condition, as was early shown by Fenwick. . . . In diffuse carcinoma, the mucosa has been found atrophic, with or without extensive erosion. . . . In diffuse colloid cancer the gelatinous nodules may be widely distributed over the mucosa." In his reference to sclerosing fibrocarcinoma, or Linitis Plastica, he states: "The mucosa is usually thrown into folds or nodular elevations, or it is thin, eroded or ulcerated."

From these statements, then, our findings by radiographic demonstration of the rugae might well be inferred.

Adenocarcinoma is to be recognized by the presence of the mass projecting into the lumen of the stomach, while the rugae would be enlarged or absent, depending upon the presence of hypertrophic or atrophic changes of the mucosa.

The diffuse carcinoma presents a somewhat smooth mucosal surface, with or without evidence of ulceration. This type presents a very characteristic appearance with its stomach often of decreased size, absence of mucosal folds and occasionally, also, evidence of ulceration.

In the scirrhus type, the rugae are again absent and the small oval or rounded nodulations as noted above, are demonstrable.

In gastric ulcer the early pathological process is erosion of the mucosa, which may increase in size and depth to definite crater formation. The former would be represented in this examination by a more or less rounded collection of opaque mixture, surrounded by rugae of perhaps normal formation. At a later stage, definite contracture may occur at the point of ulceration due to the newly-formed cicatricial tissue. In this instance the rugae are noted as radiating in all directions from this point. Gastric ulcer is frequently accompanied by a chronic hypertrophic gastritis, and in that case the rugae are noted to be of increased size.

FIG. 5. Roentgenogram of normal mucosa—rugae in orderly formation; those of the pars pylorica not well demonstrated on account of presence of secretion and disturbance by palpation. Small amount in bulbus duodeni.

Having briefly considered the gross pathological changes of the mucosa consequent to the more common gastric lesions, it is at once realized that any information gathered from this study should include:

1. Type of stomach
2. Size of stomach
3. Rugae
   - (*a*) number
   - (*b*) size
   - (*c*) course
   - (*d*) continuity
4. Mucosa
   - (*a*) regular
   - (*b*) irregular { eroded / nodular

Method. A fifty per cent mucilage of acacia is employed, to which an equal quantity (by volume) of bismuth subcarbonate is added. The official U.S.P. mixture contains 35 per cent acacia, but as usually procured, does not have such content. The mucilage as suggested is readily made by adding directly powdered gum arabic to an equal volume of water; this is stirred well for about five minutes and allowed to stand; after a short time a clear solution will result. When ready for use, equal quantities of bismuth subcarbonate and this special mucilage are well mixed. It is easily administered and while not unpleasant, the taste may be improved by adding a very small quantity of flavoring agent. Honey has been substituted for the mucilage of acacia, but for certain reasons has not served as satisfactorily. The examination is best made in the morning, the patient having had no food since the previous evening and having previously been prepared by catharsis.

Administration. The mixture is best administered while the patient is in a partially recumbent position (about 10° incline) on the fluoroscopic table; a level teaspoonful is given. In this work a table especially designed for examination of the alimentary tract in the horizontal position is used. This consists of a table-top (Fig. 8). Its upper third may be raised to the desired angle, as a simple bed rest. This special table top is not necessary, however, but convenient, as change of position of patient is desirable during this procedure; the table-tilt type of fluoroscope would probably be more advantageous, since a constant target screen distance is maintained with increased angulation. After the mixture has settled in the pars cardia, the back rest is elevated gradually. The patient should not be permitted to raise himself. Observations are made until the rugae are well delineated. Palpation is undesirable, as it produces an irregular distribution of the mixture and changes the conformation of the wall. Exposures are made directly after placing the sc eened film

FIG. 6. Roentgenogram of normal mucosa. First exposure.

FIG. 7. Same case as in Figure 6, exposure being made about two minutes later, patient having remained absolutely still. No change of relation or position of the rugae has occurred; at this time a larger amount has reached the duodenum.

in position. Stereoscopic plates have also been made in this manner. For demonstration of the anterior wall the procedure is applied with the patient in the prone position.

Certain obstacles may be encountered in the attempt to coat satisfactorily these walls. In ulcer or other cases in which secretion is excessive, it is sometimes necessary to remove same. If a large amount of mucus is suspected it is well also to irrigate with a sodium bicarbonate solution. Another undesirable feature is the deep shelving of the cardiac portion of the stomach, which may, however, be avoided to a large degree by proper preparation.

Special attention must be given the consistency of the mixture; if too thick, there occurs a tendency to traverse the wall en masse without coating it, and if too thin, it too readily finds its way to the lower pole.

The method of examination as suggested has already served very satisfactorily in:

More detailed and confirmative evidence of gastric ulcer.

More complete study of gastric neoplasm.

Differentiation of extra gastric pressure defects from intrinsic lesions.

The more satisfactory examination of the enterostomized stomach.

The study of gastritis.

Demonstration of the small intestine.

1. *More Detailed and Confirmative Examination of Gastric Ulcer.*

Usually gastric ulcer is readily recognized by the contour method; and the larger its crater the more easily is it demonstrated. There occurs, however, occasionally, a lesion of such small size or so shallow that it may be sighted only momentarily during fluoroscopy. Attempts to demonstrate again this condition may be unsuccessful. Distention of the stomach by a large quantity of mixture obliterates such a deformity completely, and thus the findings are indecisive. A second type of ulceration proving evasive is that confined to the anterior or posterior wall, pars pylorica, without evidence of infiltration or spasm of either curvature.

Radiographic demonstration of the mucosa offers proof conclusive of such ulcers, since the mixture invariably finds its way into the pouch, however shallow, and adheres to this localized area. By this

FIG. 8. Wooden table-top as used. Note foot-board to prevent slipping of patient.

means, we have been able to render a definite diagnosis in an otherwise indeterminate case.

Further, such study affords valuable information concerning the ulcer, which has already been recognized in the usual way. The size of the crater may be more accurately determined, its margins more readily demonstrated as well as the condition of the surrounding mucosa, and the degree of cicatrization. The latter point is distinctly shown by the course of the rugae in the region of the lesion. With such scarring is noted a puckering at the

FIG. 9. Gastric ulcer of lesser curvature, demonstrating collection of mixture in crater and rugae radiating from same due to contracture at this point; rugae ill-defined on account of breathing.

crater with radiation of the surrounding rugae from that point (Figs. 9, 10 and 11).

If contraction has not occurred the rugae extend as normally (Fig. 13). Again, the rugae accompanying gastric ulcer may be seen to be definitely enlarged, due to the associated hypertrophic gastritis. This method then offers a more complete examination of gastric ulcer and should assist materially in interval study to note the progress of repair during treatment of this condition.

2. *More Complete Study of Gastric Neoplasm.*

The roentgen study of carcinoma of the stomach by the usual method is somewhat limited by our inability to determine accurately the extent of the infiltrative type of lesion. As one might readily infer, this point is more definitely established by

FIG. 10. Lesser curvature ulcer, with cicatrization.

observation of the intima. The zone of involvement is recognized by the obliteration of rugae in a relatively small stomach and in certain cases by the irregular nodular appearance of the mucosa (Fig. 14). Such a picture is most striking and not only serves as an indication of extent of involvement, but, more important, offers a definite diagnosis to the less experienced. It may not be amiss to remark that the infiltrative variety of new growth may escape detection, as its early recognition is not always an easy task.

The medullary or fungoid growth ordinarily produces a typical gross defect. Consequently, it is infrequently overlooked, and examination by a special method is rarely necessitated; yet, in the growth of small size, confirmation may be desirable. Such mass is represented by an absence of the mucosal folds in the affected zone, and the encircling of the tumor by the mixture so that it is directly outlined. In the presence of an accompanying atrophic gastritis, the rugae are obliterated.

3. *Differentiation of Extra Gastric Pressure Defect from Intrinsic Lesions.*

Not infrequently a regular deformity of one or the other curvatures of the stomach confronts the roentgenologist, and demands a differentiation of pressure defect from an intrinsic lesion. Ordinarily this is easily and satisfactorily accomplished; but in an exceptional instance, the findings may not be conclusive.

From the foregoing description of the normal and pathological mucosa as demonstrated radiographically, one immediately sees the marked contrast between the two cases. In the case of deformed contour resulting from an extragastric pressure defect, the rugae of a normal mucosa are noted, while the characteristic findings of an infiltrated mucosa as described above are seen in the case of intrinsic lesion (Figs. 15 and 16). This single finding at once suffices for a definite conclusion.

FIG. 11. Ulcer, posterior wall of stomach with less marked contracture. Mixture has passed into jejunum.

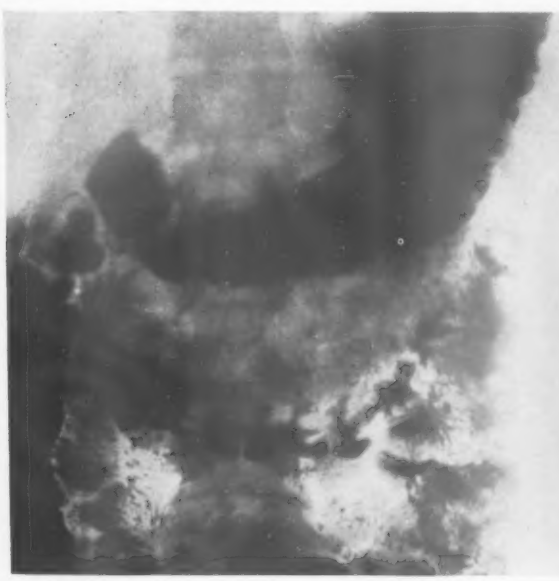

FIG. 12. Examination by "contour" method. Note very small niche of ulcer lesser curvature, pars media.

FIG. 13. Same case as in Figure 12, demonstrating ulcer much more satisfactorily; note that radiating rugae are not present.

4. *The More Satisfactory Examination of the Enterostomized Stomach.*

The difficulty encountered in directly demonstrating the stoma by the commonly used method is generally appreciated. Frequently, the evacuation of the liquid through the enterostomy of large size is so rapid as to render its visualization very unsatisfactory; then too, the stoma of high position is frequently obscured by the opaque mixture in the lower pole of the stomach. With the method suggested the mixture descends the posterior wall and in its slow passage through the gastroenterostomy opening, renders this portion plainly visible (Fig. 17). It thereby reveals the slightest deformity of its contour, and consequently offers a more efficient means for the determination of pathological states of the newly-formed canal and the jejunal loop.

FIG. 14. Mucosal surface of diffuse scirrhus carcinoma of stomach (autopsy); note absence of rugae formation and nodulated appearance of mucosa. Too much mixture had been administered, and insufficient time allowed for the evacuation of excess.

5. *The Study of Gastritis.*

Little attention has been paid to the size of the rugae as an indication of chronic hypertrophic and atrophic gastritis, presumably because these folds vary so widely in different individuals.

In hypertrophic gastritis the mucosa itself is thickened from cellular infiltration and the submucosa presents a hyperplasia of connective tissue elements; these changes tend to produce greater prominence of the mucosal folds, by their increased size and irregular course (Fig. 18). It has been frequently noted radiographically that enlarged rugae accompany organic lesions, particularly ulcers of the stomach, less commonly of the duodenum. The presence of an associated chronic gastritis is generally conceded in these conditions, and it is therefore assumed that such enlargement of the rugae is due to the underlying gastritis.

Marked variation of rugae formation has been noted in cases presenting no other evidence of abnormality. It was best demonstrated in days past in those patients from whom a pronounced alcoholic history was elicited. The association of alcoholism and gastritis is appreciated and for this reason also the enlarged size of the rugae was considered an indication of the hypertrophic changes produced by this chronic irritant. The enlargement and irregularity of the rugae referred to are very distinctive, and by this method contrast with those seen normally. As mentioned, the atrophic type of gastritis presents a marked thinning of the mucous membrane and consequently a decrease of size or complete absence of rugae.

6. *Demonstration of the Small Intestine.*

On account of the rapid passage of the liquid mixture commonly employed through the upper small intestine, study of the jejunum and proximal ileum is rather difficult, but in the method suggested this thicker mixture travels more slowly and tends to coat the walls, thus rendering a satisfactory visualization of them (Fig. 19). Fortunately, organic lesions of the jejunum and upper ileum are rare, but for certain studies one may be desirous of more complete radiographic investigation, and in this event the method suggested offers such an opportunity.

While this work is yet incomplete it is anticipated that study of the mucosa will prove of further advantage in:

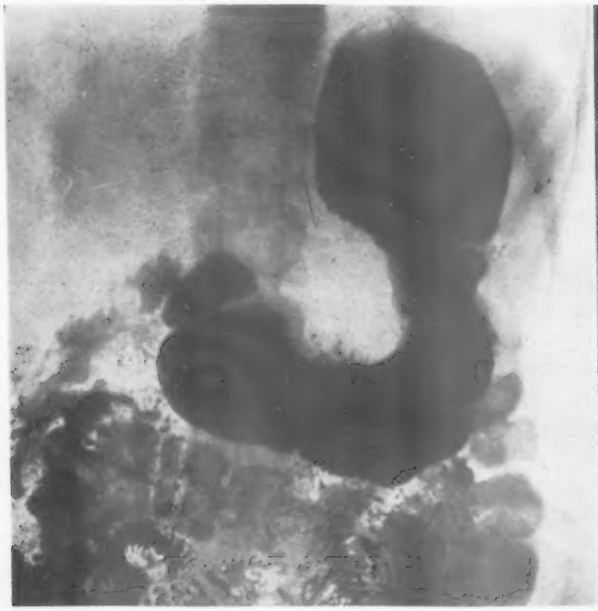

FIG. 15. Roentgenograph after contour method. Deformity of lesser curvature to be differentiated from extra gastric pressure defect. See Figure 16.

FIG. 16. Same case as in Figure 15. Demonstration of mucosa reveals an intrinsic lesion, a more extensive carcinoma than might be suspected from examination by contour method. The spasm of greater curvature is not noted by this method, as in previous figure.

FIG. 17. Special demonstration of gastroenterostomy; evacuation through the newly formed opening was so rapid during the routine examination that the stoma could not be visualized. Note how well-defined is the gastroenterostomy opening by this special method; jejunal loop also satisfactorily demonstrated.

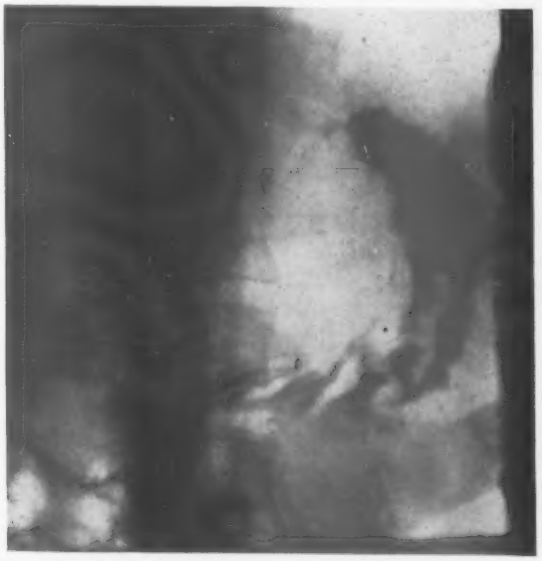

FIG. 18. Mucosal study of case considered to be chronic hypertrophic gastritis; no organic lesion noted. The rugae, in this instance, are not as tortuous as those sometimes noted.

The detection of the mucous erosion.

More definite differentiation of benign and malignant ulceration.

The differentiation of spasm from organic lesion.

The differentiation of duodenal ulcer and periduodenal adhesions.

7. *Detection of Mucous Erosion.*

A simple mucous erosion is occasionally suspected when no satisfactory demonstration of it is afforded by the contour

FIG. 19. Demonstration of upper small intestine with aid of special mixture.

method of examination. The reason for this is obvious, for it cannot be expected to produce a deformity of the gastric contour, as the lesion is confined to the mucosa. Satisfactory demonstration of the mucosa should supply the means by which such erosion could be detected. While a case of this kind has not, thus far, been noted, we have been able to demonstrate much more satisfactorily an ulcer crater so small as to be barely detected by the routine examination (Figs. 12 and 13).

8. *Further Differentiation of Benign and Malignant Ulceration.*

No hope is to be offered in the differentiation of the gastric ulcer, which appears macroscopically benign and is found to be microscopically malignant, as this variety possesses no gross qualities by which it can be recognized. The differentiation of ulcerating new growth from a benign ulceration is, however, possible, as their gross characteristics differ. Ulcerating cancer is often surrounded by a zone of infiltration, its crater is usually larger and frequently it has overhanging margins; while the benign ulcer usually has a smaller crater, with less marked infiltration of its borders, and often connective tissue formation with contracture at the ulcer site. The latter is an important feature in this connection as Ewing states: "Secondary ulceration of primary carcinoma rarely produces marked contracture of the wall." The condition of the overhanging ulcer margins referred to might be demonstrated by radiographing the crater in profile after coating the intima with the acacia mixture.

9. *Differentiation of Spasm from Organic Lesion.*

Demonstration of normal rugae such as accompany spasm, at once differentiates it from an organic lesion, and renders needless the antispasmodic for this purpose. Moreover, it appears at present that spastic phenomena are much less common with this examination of the stomach in the resting state, as compared with the distended organ during the routine examination (Figs. 15 and 16). It is hoped that further experimentation will aid in more definitely establishing this important feature.

10. *Differentiation of Duodenal and Periduodenal Adhesions.*

Up to the present, satisfactory work has not been completed in this connection, nor has sufficient data been collected for definite statements, but it seems logical to assume that demonstration of the duodenal mucosa is also practical and the differentiation of organic lesions of the duodenum from spastic and adhesion defects might be accomplished by this method. If this is sustained, one of the great sources of error in the diagnosis of disease of this portion can be eliminated. It is thought that the deformity due to adhesions and spasm of this part are much less marked with this method than when the stomach and duodenum are distended as in the usual examination.

The method described may also serve in the case of the patient who, for one reason or another, might be unable to take or retain the amount of liquid mixture necessary for satisfactory examination by the commonly used method.

It is sincerely hoped that the work suggested will stimulate further endeavors along these lines. Up to the present time, relatively little attention has been accorded the condition of the mucosa. It is, nevertheless, a very important pathological feature, a knowledge of which offers a keen insight into the gross anatomical changes of the hollow viscera.

The radiographic demonstration of such abnormalities appears so characteristic that it should also serve as a corroborative examination, and materially reduce the number of errors of the less experienced workers in the radiological field.

A CASE OF SYPHILIS OF THE STOMACH

BY SAMUEL F. WEITZNER, M.D.

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SYPHILIS of the stomach is generally regarded as an uncommon disease, but the increasing frequency of reports of cases in the literature indicates that it is not quite as uncommon as was formerly supposed. The difficulty in diagnosis lies in establishing a connection between the local gastric lesion and the general disease.

No attempt will be made to discuss gastric syphilis in general or to review its literature. It is desired that the following be considered simply as a case report:

Male, sixty-one years old, a tailor by occupation, was referred for roentgenological examination of the gastrointestinal tract. His chief complaint was cramps in the abdomen, not definitely localized, but slightly worse in the umbilical region. His cramps began eight days before the *x*-ray examination, and had become gradually more severe. He was nauseated and had vomited some bile-stained fluid. There was no blood in the vomitus. There was no fever and the pulse rate was 80 per minute and of good quality.

Past History. The patient denies having had a chancre or any secondary syphilitic manifestations. He has had no gastrointestinal complaints except occasional constipation, until the present time. There was no loss in weight preceding his present illness.

Physical Examination of the abdomen revealed a general rigidity of the abdominal muscles, which the patient could not relax. Satisfactory palpation could not be performed because of this muscular tenseness, but a definite point of tenderness was found about two inches above the umbilicus in the median line. Pupils and knee-jerks were normal. The heart, blood-vessels and lungs showed no unusual physical signs.

Roentgenological Examination, in brief, showed a marked filling defect in the pars media of the stomach. The defect involved both the greater and the lesser curvatures and the lesion had considerably diminished the capacity of the stomach. There was no gastric residue at the end of six hours. Intestinal motility was normal. Conclusions: Large neoplasm in the pars media of the stomach. Because of the large size of the neoplasm with comparatively moderate symptoms and very recent history, syphilis was suspected and a Wassermann test advised.

Subsequent History. At a well-known hospital to which the patient was now taken, a diagnosis of inoperable carcinoma of the stomach was made and the patient returned home. In the meantime, the nausea, vomiting and cramps had ceased. Wassermann tests, now performed, were positive (four plus).

Intensive antisyphilitic treatment was instituted, intravenous arsphenamine, mercury intramuscularly and potassium iodide by mouth. The rapid subsidence of symptoms under the antisyphilitic treatment

was very gratifying. Early in the course of treatment improvement was noted, and by the time the entire course had been administered, the patient was clinically well.

He was again referred for examination exactly six months after his first examination, and the stomach was seen to be radiographically normal. The site of the large defect in the pars media now showed normal in contour, peristaltic waves were seen to pass over areas which they had previously skipped, and the normal capacity of the stomach was restored.

FIG. 1. Filling defect in pars media.

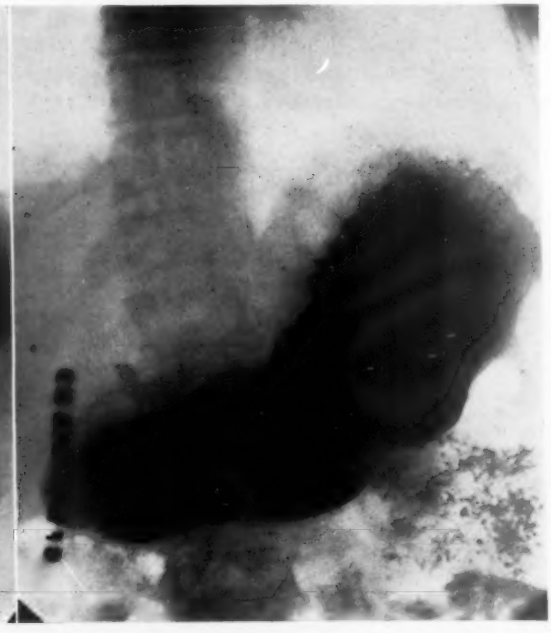

FIG. 2. Six months later, after intensive antisyphilitic treatment. Stomach normal in contour.

SUMMARY

A patient sixty-one years old begins to complain of gastrointestinal symptoms. Roentgenologic examination discloses the presence of a neoplasm of the stomach, which might readily be considered of malignant nature.

Its luetic nature was proven by the four plus Wassermann reaction, and the rapid restoration of the stomach to normal, following active antisyphilitic treatment.

REPORT OF A CASE OF ADENO-PAPILLOMA OF THE STOMACH*

BY I. S. INGBER, M.D.

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THE general belief is prevalent that all adeno-papillomata of the stomach are of a cancerous nature.

Most of the accumulated information on this subject has emanated from pathological institutes where the studies have been based on specimens found at necropsy in patients who have died of other diseases.

With the advent of the roentgen method of examination of the gastrointestinal tract, we are slowly accumulating additional valuable information about these rare types of gastric tumors.

History of Case

Male, aged sixty; occupation, letter-carrier; married, and father of healthy children.

Family History. Negative.

Past History. Had pneumonia ten years ago. Recovery was good; no complication or sequelae.

Present History. Patient entered hospital because of shortness of breath, cough and swelling of the legs.

Clinical Examination. Sputum showed slight traces of blood. Negative for tuberculosis.

Wassermann. Negative.

Blood Count. Showed a moderate secondary anemia.

Gastric analysis was not done.

Patient was treated for his cough, dyspnea and swollen legs, which promptly improved under rest and medical treatment.

Upon further questioning of the patient after recovery from his actual illness, a story of the gastric disturbances was elicited, which is sufficiently interesting to be recorded in full.

The patient had suffered from so-called dyspepsia for the previous eight or nine years, for which he took numerous medicines, but without relief.

The attacks of dyspepsia were periodical. The patient stated that with the onset of such an attack, he would regurgitate what he described as sweet water. The regurgitation would come on mostly at night between 1 and 2 a.m. He would be awakened out of a sound sleep and run to the bathroom and regurgitate this so-called white, sweetish,w atery liquid. During the vomiting attack, according to

Fig. 1. Round filling defect in pars media showing characteristic distribution of barium mixture in area of defect, due to polypoid character of growth.

the patient's description, his stomach would be tied up into a knot. This feeling would continue for about five minutes after he was through vomiting. His stomach would then relax and the attack would be followed by general abdominal soreness which would last for about one hour. These stomach spells would occasionally occur in the day-time, but only after eating certain kinds of oranges or apples.

There had been no loss of weight in the past ten years.

The roentgen examination by means of the customary barium and buttermilk

* Paper submitted with application for membership in The American Roentgen Ray Society, 1922.

mixture showed the presence of a round, circumscribed defect in the pars media, situated close to the greater curvature. Both the greater and lesser curvature were intact, there being no break in their continuity. The defect was about 1½ in. in diameter. In the center of the defect were seen small strands of barium.

There was no delay in gastric motility, the stomach being empty at the six-hour examination.

Roentgen Conclusions. Polypoid growth of the stomach situated in the pars media.

Operation. The tumor was found on the anterior wall of the stomach, and was removed by a partial resection of the anterior wall. The patient made a slow but uneventful recovery.

Pathological Findings. Macroscopically the growth presents the appearance of a cauliflower, the size of a small apple, arising from three slightly separated peduncles.

Vertical sections through the peduncle showed the gastric wall to be normal from the serosa to the muscularis mucosa. The growth arises as a conglomeration of villous processes from the tunica propria, branching fan-like from the peduncle, the larger branches giving off secondary protrusions. The typical glandular structure of the fundus portion of the gastric mucosa is preserved throughout. Vascularization is good. There is no evidence of malignancy.

Diagnosis. Adeno-papilloma of the gastric mucosa, non-malignant.

DIAGNOSIS OF OBSCURE ABDOMINAL LESIONS BY THE ROENTGEN GASTROINTESTINAL EXAMINATION*

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THIS subject as presented today is not in the form of a finished investigation, but rather a report of a few notes and observations which will, we hope, be added to by other observers. In this way will be built up a method of diagnosis of these conditions as accurate as those of gastric ulcer and gastric cancer today.

In a routine hospital clinic the radiologist is often confronted with a case where the diagnosis is a large interrogative mark; every clinical method had been applied and still the case is undiagnosed. The patient is presented to the radiologist with the statement, "Mass in epigastrium," "Prove presence or absence of malignancy," or "Vague abdominal symptoms."

It was this type of case that gave the impression, "We are not getting all the information present out of our serial plates and screen-work, and we are too easily satisfied with a negative diagnosis of intrinsic intestinal pathology. At the same time we are overlooking information relative to the extra intestinal lesions as accurate as Haudek's niche in ulcer, or the clover-leaf deformity of duodenal ulcer."

The information has been passed only too often with the statement, "Extrinsic pressure," "Extragastric tumor," or some other just as indefinite statement.

We refer to the filling defects and deformity of the stomach, duodenum and colon caused by pancreatitis, carcinomas, cysts of the pancreas, retroperitoneal tumors and other extraintestinal growths.

When an attempt was made to review the literature on the subject, we were impressed by the lack of anything of a definite nature, the articles by Hickey of Ann Arbor and Herrenheiser of Vienna on pancreatic carcinoma being the only ones noted.

The technique is exactly the same as is used in all our routine gastrointestinal examinations. The patient is presented fasting, and 20 oz. of buttermilk with 4 oz. of barium used as the opaque meal. Fluoroscopic examination with palpation of the stomach and duodenum are done in the

* Read at the Midwinter Meeting of the Eastern Section of THE AMERICAN ROENTGEN RAY SOCIETY, Atlantic City, N. J., Jan. 25–27, 1923.

erect posture and anteroposterior directions. Both diaphragms are investigated for position, shape, and movement. Oblique observation is also done in the erect posture, noting any deviation from normal. If any abnormal condition is noted, a series of six plates is made in the erect posture.

The patient is then lowered into the prone position, where further fluoroscopic examination and palpation are done, with a series of ten $6\frac{1}{2} \times 8\frac{1}{2}$ and two 11×14 plates.

The right oblique is then assumed, when screen work is again carried on, and if deemed necessary, a series of five plates is made here.

In the earlier attempts to differentiate these conditions, the pneumoperitoneum method was carried out; but we found that, as far as we were concerned, more information could be obtained by the routine method, with less discomfort and certainly much less risk to the patient.

In making the observations, two definite goals were kept in view: (1) Localization of the anatomical situation of the lesions. (2) Establishment of the pathological entity of the condition if possible. It was found that the localization of the anatomical site was not so difficult; and if that is all we can obtain, it will be of great value to the surgeon, giving him the line of attack, and indicating whether an intra- or extraperitoneal route is advisable; often, indeed, with a conservative surgeon, resigning the case before unnecessary and fruitless exploration has been undertaken.

FIG. 1. No. 89056. Roentgenological diagnosis: carcinoma of pancreas. Autopsy: carcinoma of pancreas.

FIG. 2. No. 78621. Roentgenological diagnosis: carcinoma of pancreas. Surgical findings: carcinoma of pancreas.

If we recall the comparatively few organs lying in the upper abdomen, it will be seen how quickly tumor formation will give rise to filling defects in the stomach, duodenum, jejunum and colon.

The liver, pancreas, spleen, kidneys, gall-bladder and retroperitoneal area are all subject to tumefaction independent of any primary focus in the bowel, and by this tumor formation give pressure on the adjacent hollow viscus.

This pressure is usually characteristic, and by it the lesion is localized and often the type can be recognized.

In liver conditions, the involvement most frequently encountered is secondary, due to a primary elsewhere, the primary often being found in the gastrointestinal tract. When the whole organ is enlarged, we get a displacement downward and forward of the hepatic flexure and first portion of the transverse, with a displacement to the left of the caput and pyloric end of the stomach and an approximation of the descending duodenum to the caput.

The duodenum is greatly deformed, particularly the second portion. It is not the deformity seen in adhesions of benign gall-bladder disease, but is firm in appearance, irregular in its course, valvulae conniventes are absent and the angulation is always toward the lower and under surface of the liver. When we palpate the involved area, it moves en masse, if it moves at all. In the serial plates, when one is superimposed on the other, the

FIG. 3. No. 84075. Roentgenological diagnosis carcinoma of pancreas. Surgical findings: carcinoma of pancreas.

FIG. 4. No. 111024. Roentgenological diagnosis: tumor of pancreas, probably carcinoma. Autopsy: carcinoma of pancreas.

When the middle portion is involved, we get pressure on the lesser curvature of the stomach. Peristalsis is lessened, but not absent. The curvature assumes a crescentic shape. The deformity varies greatly with inspiration and expiration. On palpation gastric rugae can be seen. There is in these cases no change in the descending or transverse duodenum.

Gall-bladder. We have been fortunate enough to have several cases of carcinoma of the gall-bladder where the diagnosis was made from the duodenal deformity, and the extension to the stomach of the growth. All of them were confirmed at operation.

region of the duodenum involved will always fit exactly. In the gall-bladder region, in two cases, we have been able to see the enlarged gall-bladder with irregular outline, which was additional evidence.

Pancreas. Tumor of the pancreas is probably the easiest of any of the extragastric lesions to place anatomically. However, at times there is great difficulty in arriving at a correct statement as to the type of pathology present. Pancreatitis, cyst, carcinoma, all give filling defects of the stomach and duodenum.

Pancreatitis is usually secondary to a chronic inflammation of gall-bladder,

FIG. 5. No. 102390. Roentgenological diagnosis: tumor in tail of pancreas. Surgical findings: carcinoma in tail of pancreas.

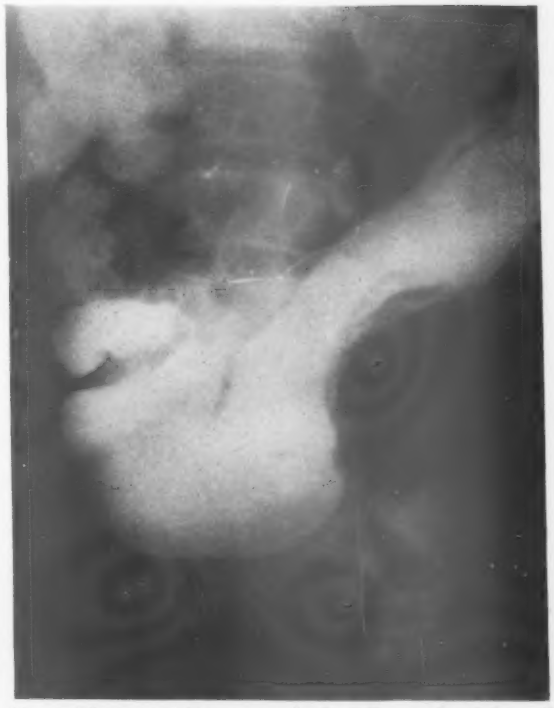

FIG. 6. No. 82406. Roentgenological diagnosis: right and left nephrolithiasis, with left side hydronephrosis. Autopsy: left and right nephrolithiasis with left side hydronephrosis.

FIG. 7. No. 96673. Roentgenological diagnosis: retroperitoneal tumor in left renal region. Surgical findings: hypernephroma of left kidney.

FIG. 8. No. 58973. Roentgenological diagnosis: retroperitoneal tumor on left side with accessory pocket communicating with third portion of duodenum. Surgical findings: retroperitoneal sarcoma with direct extension to and perforation of third portion of duodenum.

appendix, or other abdominal infection, and most frequently follows the chronically infected gall-bladder. On account of this, adhesions are often present and act as guide-posts in the process of elimination. The chief seat of involvement is the head. This gives a slight displacement upwards of the pylorus and presses it slightly to the left. The caput assumes a more or less horizontal position. The descending duodenum describes a larger arch than is usually seen.

FIG. 9. No. 85982. Roentgenological diagnosis: primary carcinoma of gall-bladder with direct extension to duodenum and pylorus. Surgical findings: carcinoma of gall-bladder extending to duodenum and pylorus—direct extension.

Cyst of the Pancreas. When cysts of the pancreas are present they are recognized only when of sufficient size to give filling defects. They produce a clear-cut outline of pressure in the stomach and duodenum, depending on the site of the cyst in the pancreas. In the head they displace the pylorus to the left, the caput upward and horizontally, the descending duodenum outward and to the right. The outline is smooth. Rugae are present in the stomach and valvulae conniventes in the duodenum. On palpation it can be shown that the tumor mass is free from the stomach and that the mass does not move with respiration.

If situated in the body of the gland, the pars media of the stomach is the site of the filling defect, and this is noted on the greater curvature. The filling defect is small or large, depending on the size of the cyst. It is smooth in appearance, and the rugae of the stomach are seen through it. On palpation of the stomach, it may be lifted away from the tumor mass and the tumor is immobile with respiration. In the erect position, nothing may be seen unless deep palpation is undertaken, the filling defect being most pronounced in the prone position.

FIG. 10. No. 103448. Roentgenological diagnosis: tumor of head of pancreas. Surgical findings: cyst in head of pancreas.

Cysts of the tail give their filling defect on the lesser curvature. There is little to be seen in the erect posture, only deep palpation bringing out the tumor. It is the prone position here that gives the most information.

Occasionally one will get a pedunculated pancreatic cyst that cannot be

localized. In one case the tumor was freely movable and we were of the opinion that it was a mesenteric cyst. At operation it proved to be a pedunculated cyst of the pancreas arising from the anterior surface of the tail.

Carcinoma and Sarcoma of the Pancreas. While we cannot always differentiate the type of neoplasm, we can with a fair degree of certainty state that it is malignant. The situation of the growth in the different regions of the gland give various filling defects. The head of the gland is the position most frequently attacked by malignant growth. On account of the close relationship of the descending duodenum, early deformity occurs and recognition is easier here than in the body or tail. The descending duodenum becomes involved, particularly close to the ampulla of Vater. It is fixed, irregular, the valvulae conniventes are gone and will show areas of constriction and dilatation. When the several plates are superimposed the matching will be perfect in the involved area. This appearance may be present in several places with healthy bowel between, or a single elongated area may exist. As the disease progresses, the pylorus is displaced to the left.

When the neoplasm is situated in the body of the gland the deformity is very like that caused by cystic disease, with this exception: that the transverse duodenum shows evidence of pressure and loss of valvulae conniventes, which is not found with simple cyst, and the pressure outline in the stomach is irregular.

When the tail is involved the deformity is noted on the lesser curvature. An irregular filling defect is seen, which on palpation can be increased or lessened and does not move on respiration; at the same time the rugae of the stomach are present.

Spleen. Tumors of the spleen are easily recognized by the deformity they give in the barium-filled stomach and by the deformity of the splenic flexure with the barium enema. The enlarged organ with its smooth, even contour may be seen displacing the stomach to the right with the greatest pressure near the fundus, giving the stomach an atypical hour-glass appearance. The splenic flexure is dislocated downward, and the lower pole of the organ may be outlined by the latter part of the transverse and the splenic flexure.

Unfortunately, various types of splenic tumor give the same radiological appearance and the etiology of the tumor has to be arrived at by other methods of examination. In cases of tuberculosis of the spleen the calcified plaques often are of aid in the correct diagnosis. We were

FIG. 11. No. 85691. Roentgenological diagnosis: tumor of head of pancreas involving duodenum. Autopsy: sarcoma of pancreas.

fortunate enough to have this present in three cases.

Kidney Tumors, when of sufficient size give very definite displacement of the duodenum, stomach, and jejunum.

When the tumor is present in the right kidney, the stomach, particularly the caput and pylorus, is displaced forward and to the left. The descending duodenum is pushed forward and approaches the midline of the body. In advanced cases the stomach in the anteroposterior position has the appearance usually seen when visualized in the lateral direction and vice versa. The hepatic flexure and ascending

colon are displaced forward and to the right. In stereoscopic plates these portions may be seen outlining the growth and anterior to it.

In tumors of the left kidney the stomach is displaced upward and forward with pressure on the greater curvature. The duodenal jejunal juncture is pushed forward and toward the mid-line or over it, and the descending colon is displaced to the left and in the stereoscopic plates is seen anterior to the tumor.

Retroperitoneal growth. Retroperitoneal sarcomas frequently present themselves in a general clinic. Radiologically they give filling defects not unlike those of kidney tumors, but as a rule are more irregular. Good Bucky stereoscopic plates are of great value here as they help to give the outline of the normal kidney and so aid in a differential diagnosis.

Lymphosarcomas, mesenteric cysts, pedunculated cysts of the pancreas give filling defects in the small bowel or colon, but unfortunately do not give any characteristic deformity at present. We have to be satisfied in these cases with the statement that the tumor is of extra intestinal origin, the diagnosis being made at the operating table or in the autopsy room.

DISCUSSION

Dr. Pfahler. During December I had the privilege of visiting Dr. Dickson in his laboratory at the Toronto General Hospital. He spent about two hours explaining some of these cases he has shown you today. He took a great deal more time on the individual cases to tell how he arrived at his conclusions.

I am quite sure that you think he is a very good guesser, but let me tell you briefly that it means a lot of hard work in each individual case.

I think if we all do a little more studying when something unusual presents itself, we will make more of these brilliant diagnoses and also increase our accuracy.

There was one case—the last one shown—which reminds me of another point. During the past summer I had the privilege of visiting Dr. Åke Akerlund in Stockholm. I think most of us have the idea that perforating duodenal ulcer is rare. Dr. Åkerlund told me that he had recognized over 300. He showed me at least 50 within the very short time I was there, but he gets them by just such manipulation (compression) and most careful study, as Dr. Dickson has just shown you. As some of you know, Dr. Åkerlund has written a book on duodenal ulcer. I think it a very excellent one.

Another point that occurs to me in connection with Dr. Dickson's demonstration is with special reference to the large stone in the kidney. I believe that if in all instances we will make a preliminary Potter-Bucky diaphragm plate of the entire abdomen, we will arrive at many diagnoses that will at least give us some clearness with regard to the kidneys, liver and spleen that otherwise might be overlooked. In our practice, as a routine, we make the Potter-Bucky diaphragm film on every case. I am one of those enthusiasts Dr. Leonard spoke of this morning, in gall-bladder diagnosis.

With regard to these other studies made by Dr. Dickson, I think we owe him a debt of gratitude for calling attention to the many variations, especially those of tumors of the pancreas. He has shown us, or at least indicated that he sees a great many. You will have to bear in mind that they are probably no more frequent in Toronto than they are elsewhere, but Dr. Dickson spends most of his day working on gastrointestinal cases. He sees a great number, but probably in proportion no greater number than we see. Therefore, in closing I can simply urge thoroughness and increased work to accomplish the results Dr. Dickson has shown us.

X-RAY DIAGNOSIS OF UNUSUAL LARYNGOTRACHEAL ESOPHAGEAL CONDITIONS AND DISEASES

BY SAMUEL IGLAUER, M.D.

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WITH the perfection in the technique of esophagoscopy, there may be a tendency to overlook the value and importance of the *x*-ray diagnosis of esophageal lesions. The information obtained by the latter method is often a great aid to the esophagoscopist, and is of great value (1) in determining the functional activity of the esophagus with the fluoroscope, (2) in getting the static condition of the esophageal lesion (3) as an aid to the introduction and fixation of appliances within the lumen of the esophagus or larynx.

Careful *x*-ray study of the esophagus will often reveal some unexpected and astounding conditions. I should like to cite a series of cases to illustrate these unusual findings.

OPEN SAFETY PIN, POINTING DOWNWARD

CASE I. That of a safety pin in the esophagus of an eight-months-old infant. While "changing" the child, the mother, a physician's wife, missed the pin at 1 o'clock in the morning, and told her husband that the child had swallowed the pin. He was inclined to doubt it, but the child was brought to the city and *x*-rayed by Dr. Doughty, who was much surprised to find the pin with the point down, lodged in the lower third of the esophagus. At 6 p.m., of the same day, upon introducing the esophagoscope, curds of milk were found in the lower esophagus. Upon withdrawing the tube, the patient regurgitated the curds and the pin, which fell upon the floor. In this case, the *x*-ray showed the pin pointed downward, in what is supposed to be an impossible position. Two explanations of this condition have been offered. One is that the pin may be swallowed closed and may open in the esophagus, and the other is that the pin may reach the stomach open, and in the subsequent act of vomiting may lodge in the esophagus with the point downward. It is difficult to conceive that either of these explanations is more simple than that a patient may occasionally swallow a pin with the point downward. In this particular case, the parents are certain that the pin was open when swallowed and that there was no vomiting after the pin had been swallowed. The pin was one inch long, and had a sharp point, which one would naturally believe would stick in the mucosa. Should a similar case occur with the same *x*-ray findings, one might consider the advisability of giving the patient an emetic and thus recovering the pin without resorting to esophagoscopy.

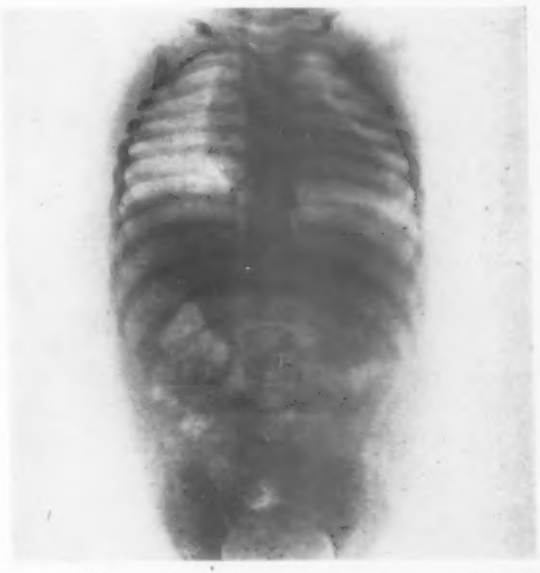

FIG. 1. Open safety pin in the esophagus, with the point downward.

NON-OPAQUE (X-RAY) FOREIGN BODIES IN THE ESOPHAGUS

The esophagus may be partially obstructed by a substance translucent to the *x*-ray. In such cases the diagnosis of the presence of a foreign body is often attended with some difficulty. I should like to cite three cases illustrating this subject.

CASE II. Female, aged fifty-eight, gives the interesting history that when she was a child she was found upon the ground, unconscious, with a pool of blood issuing from her mouth and a dead lizard lying

in the blood. Her physician and family allowed her to grow up with the belief that she had been bitten by the lizard, which caused a hemorrhage. She gives a history of having had a persistent purulent expectoration all her life until within the last few months. She stated that she frequently had some difficulty in swallowing, but that she usually managed to get the food either down or up. Her present trouble occurred two days before I saw her. While

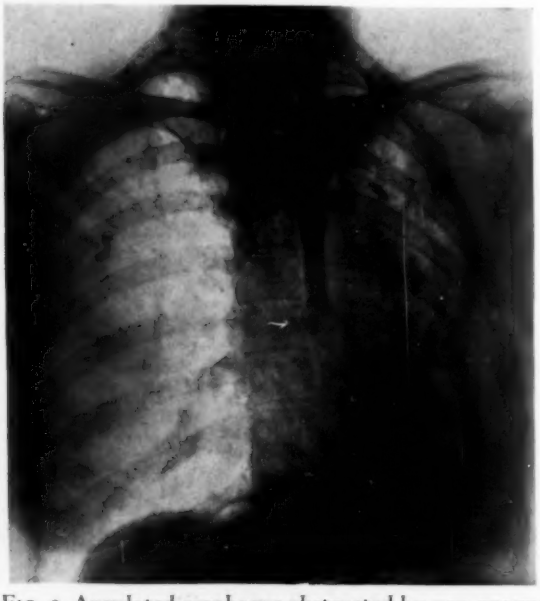

FIG. 2. Angulated esophagus obstructed by non-opaque foreign body.

eating some ham she suddenly was unable to swallow any more food. *X*-ray examination of the esophagus by Dr. Doughty was as follows:

"There is a rather definite obstruction opposite the seventh dorsal vertebra. This obstruction shows a slight dilatation at the immediate point, but there is shown no definite dilatation from there up. The characteristic marked thinning, just below, usually seen in these obstructive cases due to a malignant type of growth, is not shown.

"In the stereoscopic chest films, the entire left side is shown to be slightly fibrous. The heart and mediastinal shadows are shown to be to the left, as is frequently seen in these old fibrous types.

"Below the point of obstruction, there can be seen about the normal type of lumen of the esophagus, as far as can be made out.

"With the history of this case, it would appear to me that there is some limitation in dilating the esophagus throughout its course, possibly, slightly more at this point. In eating, the food as described by the patient, a few days ago, may have blocked at this point—that is, a rather large portion of the solid food—and which has not, as yet, let go and which does not pass on down; and therefore causes the obstruction. At the seventh dorsal vertebra, there is shown this slightly increased dilated area, which gives this impression."

The diagnosis then was a non-opaque foreign body obstructing the esophagus. I made an additional diagnosis of angulation of the esophagus by the traction of adhesions pulling it toward the left and presenting a very unusual picture. (Dr. P. Armand-Delille, in the *Journal of the American Medical Association* for Feb. 11, 1922, has pointed out that "in 10 of 300 patients with chronic tuberculosis processes in the lungs, the shriveling of tissue and other causes had pulled or pushed the trachea so far to one side that it was liable to be mistaken for a cavity.") Owing to the angulation of the esophagus I anticipated some difficulty in introducing the esophagoscope, but this did not prove to be the case, and I removed two pieces of partially ossified bone from the obstructed point in the esophagus, which was found to be slightly ulcerated at this point. Without an *x*-ray examination the peculiar distortion and narrowing of the esophagus could not have been determined in advance.

CASE III. Male, aged twenty-five, who, three days before, while eating a veal chop and potatoes had a severe choking spell. There has been marked dysphagia since the accident, and inability to swallow anything but semi-fluids. Dr. Lange reports: "Fluoroscopic observation of the act of swallowing revealed no obstruction to the downward passage of barium suspension, but large opaque capsules lodged in the esophagus about on a level with the first dorsal vertebra. The film shows three capsules lodged above a

transparent obstruction which is partly outlined by a coating of barium left from the barium suspension. It seems that the watery suspension of barium passes the obstruction freely, but the capsules do not." In this manner the site, and to a considerable extent the size, of the foreign body, which proved to be a large piece of meat, could be clearly determined.

Case IV. Seen in consultation with Dr. A. Friedlander, is even more interesting. A boy, aged six, swallowed lye two years before we saw him. Since that time

Fig. 3. Three barium capsules lodged above transparent obstruction which is partially outlined by a coating of barium left from the barium suspension.

he has had more or less difficulty in swallowing. Seventeen days before he was brought to us he told his mother that he had swallowed an orange seed. Since that time he had been unable to retain any food, not even water, and vomited almost immediately after eating. He had lost about 12 lbs. *X*-ray examination by Dr. S. Brown showed that opposite the 9th rib posteriorly there was a marked stenosis of the esophagus with a sausage-like dilatation above, and with the barium trickling through in a very thin stream below this point. Upon close scrutiny it appeared to me that there was a filling defect in the esophagus at the point of constriction, which I ventured to suggest might be due to the presence of the orange seed. The diagnosis then was "Stricture of the esophagus, obstructed by a foreign

Fig. 4. Lye stricture of the esophagus obstructed by a non-opaque foreign body, with dilatation above point of constriction.

body, with dilatation above the point of constriction." The foreign body was easily located with the esophagoscope and proved to be an orange seed. *X*-ray examination made a few days after the foreign body had been removed, showed, much to our surprise, that the esophageal pouch above the stricture had disappeared, so that by the *x*-ray examination we were able to state that the patient had had an acute dilatation of the esophagus, (comparable to an acute dilatation of the heart)

which had disappeared after the obstruction was removed.

CASES II and IV would indicate that the presence of a filling defect in a stenosed esophagus may be due to the presence of a foreign body.

UNEXPECTED X-RAY FINDINGS

CASE V. The *x*-ray examination in this case proved to be of great value both to the patient and the physicians. Female, aged seventy-nine, was seen at her residence, in consultation with Dr.

FIG. 5. Esophagus diverticulum, showing barium in the bronchial tree.

List. She stated that she had been having increasing difficulty in swallowing for the last three years, that some of the food would occasionally regurgitate, and that she had lost about 17 lbs. She was bedridden for about a week before I saw her. Owing to her extreme age, the natural inference was that she was suffering with a progressing carcinoma of the esophagus, and it seemed scarcely worth while to subject her to any examination. Nevertheless, we sent her to an *x*-ray laboratory, and upon giving a barium suspension, a large diverticulum of the upper end of the esophagus was discovered. (Dr. Schroeder, and later Dr. Brown.) In order to rule out malignant disease, the esophagoscope was passed into the pouch, but no carcinoma could be demonstrated. Gastrostomy was then performed by Dr. Ransohoff. Since that operation the patient has gained considerably in weight and may live many years as a result of the *x*-ray examination and the operation.[1]

An interesting accident occurred with this case. Immediately after the esophagoscopy, during which some cocain was used, the patient was again given barium to swallow, and the *x*-ray picture showed that some of the barium had entered and partially outlined the lower bronchial tree in both lungs. However, the patient expectorated all of this barium suspension, without any damage to the lung structure. This is in line with the experimental insufflation of the bronchi with bismuth, as described by Jackson.

CASE VI. The following case shows how the *x*-ray may occasionally make a false diagnosis, and proves that things are not always what they seem. A child was brought to the hospital with a statement that it had swallowed a five-cent piece. *X*-ray examination showed the foreign body in the usual position at the upper end of the esophagus. Upon introducing the esophagoscope, I informed the interne that the patient had six cents in the esophagus, for I could make out the edges of two superimposed coins, one brass and the other nickel. The coins were withdrawn together and proved to be a dime and a penny, so that I was five cents to the good, despite the mistake in the diagnosis.

In cases of cardiospasm, it seems very likely that by inducing pneumoperitoneum and taking an *x*-ray picture of the diaphragm we may occasionally find pathological adhesions of the liver encroaching upon the subdiaphragmatic portion of the esophagus and giving rise to the symptom complex cardiospasm. In one such case, the *x*-ray films show an enormously dilated esophagus with adhesions of the liver to the diaphragm in the area corresponding to the subdiaphragmatic portion of the esophagus.

[1] Since the above was written the pouch has been successfully removed by Dr. Ransohoff.

COCCIDIOIDAL GRANULOMA*

BY RAYMOND G. TAYLOR, M.D.

LOS ANGELES, CALIFORNIA

THIS disease, first described in this country by Rixford and Gilchrist, and named and classified by Ophuls, appears to be more common than at first suspected.

Since the attention of the staff of the Los Angeles County Hospital was first drawn to it in 1915, 16 cases have been observed up to May 1, 1921. Five of these, observed prior to October, 1917, were reported in 1919 by Dr. W. B. Bowman, who made the first detailed roentgen report noted in literature; the remaining 11 form the subject matter of this report.

A review of the available literature indicates that the following conclusions have been arrived at by various investigators:

1. The disease is caused by a specific fungus, and affects chiefly adult males of the laborer class.

2. Nothing is known of the natural habitat of the specific organism, other than the human body; however, animals such as guinea pigs, rabbits and monkeys are susceptible to inoculation.

3. There is no direct evidence of contagion, but of the total reported cases (including ours, about 61) the great majority had been, or were, residents of California, and most of these had at some time lived in the San Joaquin Valley. This would suggest the presence of a local causative factor.

4. The infection seems to be acquired from some external source, and the mode of entry is probably through the skin or by inhalation or ingestion. Primary lesions are usually either in the skin or in the lung, and the lesions in general can be classed under the head of infectious granulomata. They resemble those of tuberculosis in every way except in the presence of the specific organism.

5. When the initial lesion appears in the skin it closely simulates the more acute forms of cutaneous tuberculosis and may remain localized for several years. When the initial lesion appears in the respiratory tract, patients are invariably treated as tuberculous. Some time may elapse before lesions appear elsewhere. Apparently in a few cases the initial lesions have been in the joints. Eventually, however, wherever the initial lesion, a general infection occurs, which results fatally. The only exceptions are those few in which the extension of the disease has been limited by amputation.

6. The mode of onset, the clinical course and the pathological picture, as well as the initial lesion, are all strikingly like those of tuberculosis.

7. The disease is probably more common than has been suspected, and it seems quite probable that it occurs more frequently outside of California than has been supposed.

8. The adult forms of the fungus seem likely to produce the chronic lesions, such as nodules, while the immature and sporulating forms produce the acute lesions, such as abscesses and bone necrosis.

In our own cases here reported, we find there were two American Negroes, one Serbian, one Russian and seven Mexicans. There were three children, aged three, seven and nine years. All were males and all adults were laborers except one of the Negroes, who was a cook. All had been residents of California for a period of one year to life, and most of them had been residents at some time of the San Joaquin Valley. Sojourn in the hospital averaged about two months. Seven died in the hospital, two left and outcome is not definitely known, but disease was rapidly progressing and they were considered hopeless when they left; and two (Cases VIII and X) with disease localized in ankle and foot, recovered after amputation. Except for these two latter and Case VII, of which we have no history, and Case IV, of which we have no roentgen record, all showed roentgen or autopsy evidence of pulmonary involvement. The findings of the physical or roentgen examinations were always suggestive of tuberculosis. Five showed physical signs of pulmonary tuberculosis (Cases I, II, VI, IX, XI) on admission, and the sputum of two (Cases I and

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II) was positive for tuberculosis. Case I also showed a positive Wassermann. All showed a moderate leucocytosis, (12,000 to 26,000) except Case IX.

Positive diagnosis was made by finding the organism in the tissues, sputa, or pus from sinuses, before operation or death in all except Case VIII, in which organisms were found only after a leg had been amputated and pus from between tarsal bones obtained. Organisms were difficult and frequently impossible to find in the old abscesses and sinuses, and often only found when a new lesion was opened or aspirated. Most of our cases were in a rather advanced stage when received, and several seemed to be of a rather fulminating type and were rapidly fatal. In the advanced cases with multiple lesions it was frequently difficult to get an idea as to which was the primary lesion. Four (Cases II, VII, IX and X) apparently showed the first suspicious lesion about the ankle or foot. However no history of trauma was obtained in these cases.

Most of the localized abscesses were not red or particularly painful until after rupture, or incision and drainage, or involvement of contiguous bone. The development of large subcutaneous abscesses seemed, as a rule, to indicate a generalized infection that was invariably rapidly fatal. Most of the bone lesions appeared to be preceded by either a local skin lesion or a subcutaneous abscess. These abscesses frequently matured and broke down before any demonstrable lesion could be shown in the adjacent bone by roentgenograms.

Definite roentgen evidence of periosteal proliferation was noted in four cases (Cases III, VI, VII and VIII). That in Case III was especially marked. So far as we know, this is the first time this condition has been observed.

A very definite impression was gained that the destructive process in the bones, as shown by the roentgenograms, was, as a general rule, marked by an intensity and rapidity of development not often noted in tuberculosis, a week frequently showing a marked degree of advancement in the lesion. At autopsy the gross bone infiltration and destruction is invariably found to be considerably more extensive than would be suspected from the roentgenograms.

So far, we have been unable to observe any constant feature shown by roentgenograms which is peculiar to this disease and which will definitely differentiate it from bone tuberculosis. The fulminating type of the destructive process and the existence of a proliferative process in a rather unusual proportion of the cases is suggestive, but not by any means constant, as is also the occurrence of the disease in a rather larger proportion of adults than is usually found in bone tuberculosis.

No portion of the skeleton or particular portion of the individual bones seems to be immune. In this series, lesions were found in practically all the long bones except the femur—in the ilium, skull, ribs and spine. Joints, epiphyses and diaphyses show involvement, sometimes collectively and often individually.

For the last two years any patient presenting the rather characteristic skin lesions, soft tissue abscesses or persistent discharging sinuses has been under suspicion by the staff in the diagnostic wards of the hospital. Also during this time, in the roentgen laboratory, it has been our custom to suggest coccidioidal granuloma in lesions which appeared to be bone tuberculosis, which showed proliferation or gave the impression of an unusually acute destructive process. In this way we believe neither the staff nor ourselves have missed a correct ultimate diagnosis. However, we must confess that we have, on several occasions, suggested coccidioidal granuloma in cases that proved to be purely tuberculous.

Case Reports

Case I. Male, Negro, aged forty-four, laborer. Entered hospital Feb. 5, 1919. Died June 7, 1919. Resident eight years in county and state.

Pain and swelling in back for one month. Has bulging mass at edge left quadratus lumborum muscle.

Roentgen Examination. Chest (Fig. 1). Evidence of old tuberculosis both upper lobes. Lumbar spine, A. P. views only. (Fig. 2.) Rather marked lipping and spurs on the bodies, and some irregularities in

the lateral borders on the left of the second, third and fourth. Injection of sinus with bismuth paste shows a large irregular cavity lying along the left border of the

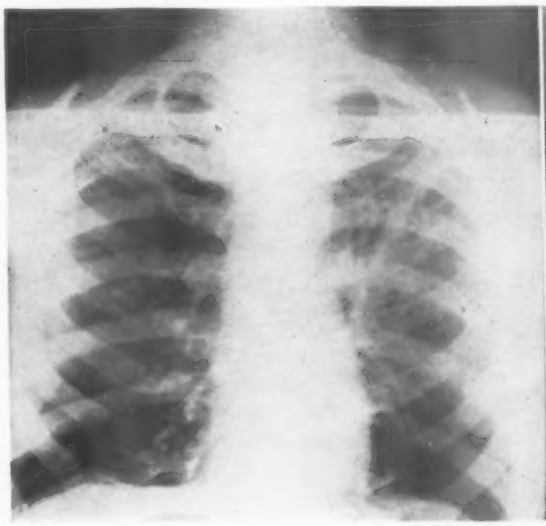


FIG. 1. Case I. Sputum was positive for tuberculosis also.

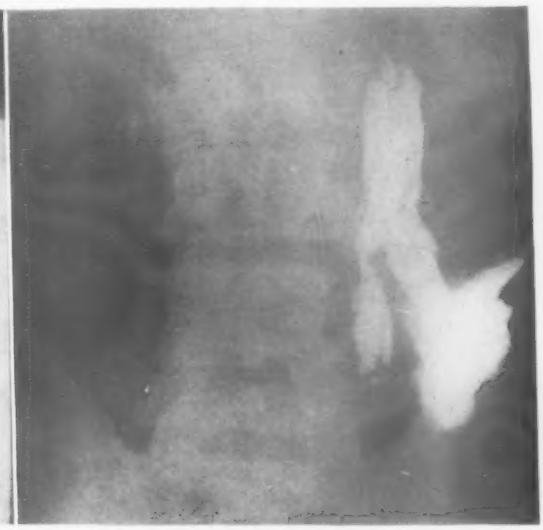


FIG. 2. Case I. Specific organism was recovered from pus from this sinus. Injected with bismuth paste.

spine and over superior portion of the ilium.

CASE II. Male, Serbian, aged thirty-four, laborer. Entered hospital March 18,

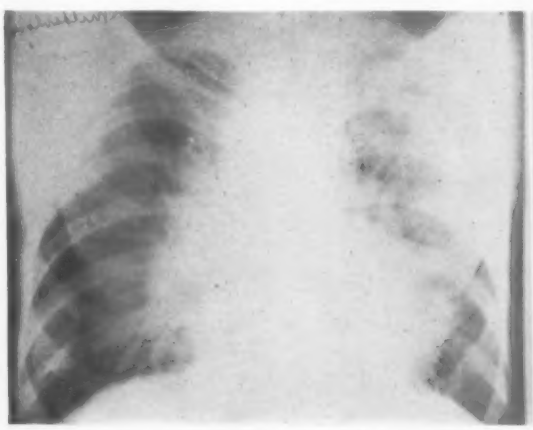


FIG. 3. Case II. Sputum was positive for tuberculosis also.

1919. Died May 27, 1919. Resident in county nine months; in state three years.

Has been in tuberculosis sanatorium for several months; admitted to hospital from there with multiple skin lesions (30) on arms, wrist, legs, trunk and scalp, varying in size from papule to walnut. Ankle swollen over inner surface: fluctuates but not red or painful. About one-half the skin lesions are broken down, have ragged undermined edges, yellowish scabs, and exude a thick yellowish pus.

FIG. 4. Case II. Probable primary lesion in internal malleolus.

FIG. 5. Case II. Note soft tissue density about lesion in metacarpal.

Autopsy. Under lesions of scalp were several areas of invasion of skull down to dura. Dura not invaded. Miliary lesions (coccidioidal granuloma) of kidneys and

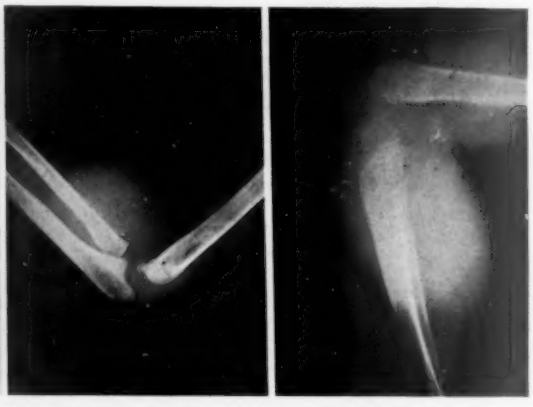
adrenals. Caseation and necrosis upper lobe left lung.

Roentgen Examination. Chest. There appears to be a tuberculosis of both lungs and a marked widening of the mediastinal

FIG. 6. Case III. Note broad upper mediastinal shadow suggesting thymus gland.

shadow (Fig. 3). Right ankle shows necrosis of the internal malleolus (Fig. 4). Left hand and wrist, a localized but marked destructive process in the proximal end of the fifth metacarpal. The carpal bones apparently not involved (Fig. 5).

Swollen right knee and ankle and multiple abscesses of arm, forearm, scalp, face and back, some discharging thick, yellowish pus. No pain except on movement right knee and ankle.



FIGS. 7 and 8. Case III. Note marked soft density and local enlargement, with no bone lesion in arm but fairly advanced lesion in upper right tibia.

Autopsy. Fibrinous pleurisy; miliary granuloma both lungs and meninges. Multiple abscesses involving subcutaneous structures, muscle and tendon sheaths and bone.

Roentgen Examination. Very definite

FIGS. 9 and 10. Case III. Right leg sixteen days later showing advance in destructive process in tibia and reduction of soft tissue density due to drainage of abscess. Note marked subperiosteal bone production in a. p. view. No involvement epiphysis.

FIG. 11. Case III. Left leg. Destructive process in tibia more marked than in right leg. Note also very marked proliferation. No involvement epiphysis.

CASE III. Male, Mexican, aged three. Entered hospital March 21, 1919. Died May 1, 1919. Resident all life in county. Family lives in shack. Uncle lived with family and died of tuberculosis one year ago. Diarrhea for year previous to entrance.

widening of the mediastinal shadow in the upper chest; suggests persistent thymus. Heart large and infantile in type. Considerable mottled density out from the right hilum and into right apex (Fig. 6). Radiographs of pelvis and femora negative.

Right and left arm and forearm show no definite bony changes, but marked increase in soft tissue density in the lower two-thirds of the right arm and upper forearm, and left upper forearm and elbow regions

FIGS. 12 and 13. Case V. Right patella. Note change in period of three weeks.

FIGS. 14 and 15. Case V. Soft tissue density markedly increased about ankle, but no demonstrable bone lesion. Autopsy two weeks later showed marked destruction of astragalus.

(Fig. 7). Lateral views of the right knee and leg show marked soft tissue swelling of the leg both anteriorly and posteriorly, and a destructive process in the proximal end of the diaphysis of the tibia (Figs. 8, 9

FIG. 16. Case VI. Marked soft tissue density and proliferation in metacarpal. Left hand for comparison.

FIG. 17. Case VI. Thickening and proliferation in upper tibia with destructive process in center. No involvement of epiphysis.

and 10). The left leg and knee show less soft tissue density, due to the fact that the abscess had been drained, but show a destructive process greater in extent in practically the same portion of the tibia (Fig. 11). There is a marked and definite layer of new bone shown under the periosteum that extends from this area to the middle and lower third of the tibia both anteriorly and posteriorly. Anteroposterior and lateral radiographs of the same area taken a little over two weeks later show an increase in the destructive process in both tibiae, and less soft tissue density due to drainage, and a very marked periosteal proliferation. This is shown in both tibiae at this time. As far as can be made out there is no involvement of the epiphyseal line, epiphyses, or the femora.

CASE IV. Male, Mexican, aged seven.

Entered hospital May 22, 1919. Discharged, not improved, June 4, 1919. No history obtained.

Scaly swelling bridge of nose. Discharging sinus under both right and left sides of mandible, right elbow, and fifth finger, left thumb, ankle and fourth toe. Enlarged inguinal glands and left popliteal tumor mass. Had what was said to be a pathological fracture of bones of right leg while in hospital.

Removed from hospital when guardian was told case was hopeless. Subsequent history unknown, but undoubtedly died. No roentgen evidence available.

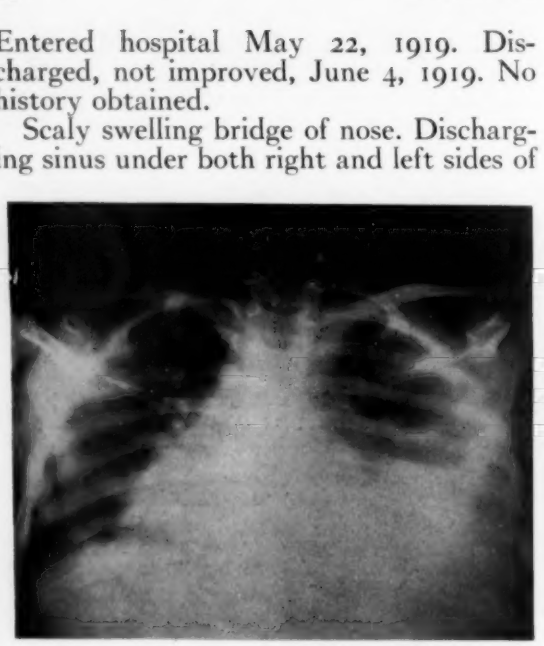
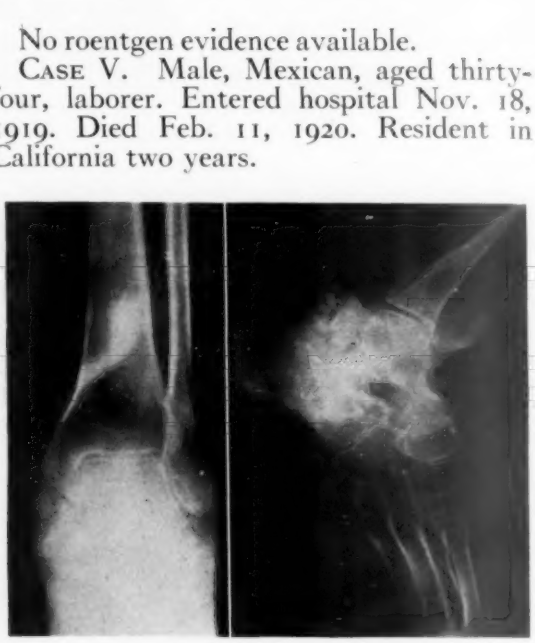


FIG. 18. Case VI. Probable fluid right base.

CASE V. Male, Mexican, aged thirty-four, laborer. Entered hospital Nov. 18, 1919. Died Feb. 11, 1920. Resident in California two years.



FIGS. 19 and 20. Case VII. Apparently no involvement of ankle-joint. Marked involvement of astragalus and os calcis with both proliferation and destruction.

Swelling left knee one month; right knee and both ankles and right hip two weeks. Joints painful and stiff. Soft reddish nodule right eyebrow one week.

FIGS. 21 and 22. Case VIII. Marked involvement both ankle-joint and tarsals. Leg amputated and patient well and working.

FIGS. 23 and 24. Case X. Destructive process internal malleolus and juxta astragalus and fifth metatarsal. Amputated. Discharging sinus in stump for a year. Recently discharged well.

Autopsy. Multiple subcutaneous abscesses. Abscesses left psoas and lumbar muscles. Encapsulated nodules, peribronchial lymph-nodes. Osteomyelitis sacrum, sternum, patella and right astragalus.

Roentgen Examination. Jan. 6, 1920. Both hips, iliae, shoulder girdles, humeri and elbows negative. Right patella, destructive process lower border (Figs. 12 and 13); left, no bone changes, but soft tissue density increased. Soft tissue density increased in left forearm near wrist, and right ankle. Examination Jan. 28, 1920 shows definite advance in destructive area in right patella; no definite bone lesion in left patella, or in forearm or ankle (Figs. 14 and 15) but marked increase in soft tissue density. No examination of spine made.

CASE VI. Male, Mexican, aged nine. Entered hospital Apr. 26, 1920. Died May 26, 1920. Resident in California five years. No history.

Admitted with tumor mass, firm, nodular, movable, in right supraclavicular fossa; large cervical and left inguinal glands. Ulceration over left hip and right posterior tibial region. Fluctuating mass dorsum right hand, index finger missing. General edema left leg and ankle.

Autopsy. Nodules cervical region positive for coccidioidal granuloma. Necrosis left ilium and right tibia. Nodules lower lobe left lung. Acute bronchopneumonia.

Roentgen Examination. Absence phalanx first finger right hand (no history); marked periosteal thickening in the second and third metacarpals, marked soft tissue density (Fig. 16). Right tibia, upper third, shows enlargement and thickening of shaft due to periosteal proliferation and thickening; 2 in. below knee-joint, area of decreased density suggesting bone destruction. Soft tissues markedly thickened (Fig. 17). Right chest dense, especially at base; suggests fluid (Fig. 18).

CASE VII. Male, Mexican, laborer. No history available at present time.

Roentgen Examination. A destructive process involving the anterior superior portion of the astragalus, the anterior portion of the os calsis, and a marked irregular proliferative process with increased density in the posterior portion of the astragalus. Ankle-joint not definitely involved (Figs. 19 and 20).

CASE VIII. Male, Russian, aged thirty-seven, laborer. Entered hospital May 5, 1920. Discharged, apparently well, Aug. 28, 1920. Resident in state seven years. Had been in Kern County Hospital one month; treated for tuberculosis of bones of foot and ankle. In January, 1920, had influenza pneumonia. In February right ankle got painful and began to swell. In March it was incised and has drained continuously since.

Admitted with discharging sinus right foot, and right inguinal adenitis.

Roentgen Examination. Destructive process, apparently very active, involving ankle-joint, and most marked in superior portion of astragalus and anterior border of tibia. Bone atrophy marked, especially in tarsals, but apparently no other bones definitely involved, except possibly lower end of fibula. Marked increased soft tissue density and joint haziness. Periosteal infiltration and proliferation in both tibia and fibula for 2 in. above joint (Figs. 21 and 22).

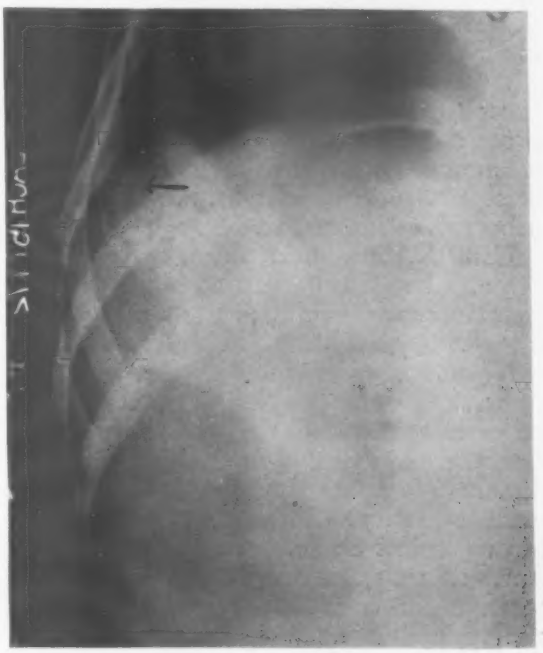


FIG. 25. Case XI. Necrosis seventh rib following subcutaneous abscess.

July 17, 1920. Leg amputated middle and lower one-third. Foot split sagitally and pus between tarsals positive for coccidioidal granuloma.

Jan. 1, 1922. Wears artificial leg and is apparently well. Works every day.

CASE IX. Male, Mexican, aged twenty-

five, laborer. Entered hospital Jan. 1, 1921. Died Feb. 7, 1921. Resident in state and county ten years. Eight months ago had "fever." For five months has had pain in back and difficult breathing. Entered hospital with discharging sinus 1 in. below right nipple, also 2 in. to the right of the first sacral segment, also right elbow. Two fluctuating masses over lumbar spine.

Autopsy. Numerous and extensive subcutaneous abscesses. Osteomyelitis lower dorsal vertebra, ribs, sacrum, and left ulna. Fibropurulent pleuritis.

Roentgen Examination. Spine negative except sacrum, which showed a destructive process present, as does also the left olecranon. Opacity of left chest, probably thickened pleura and fluid. Probably active tuberculosis right apex.

CASE X. Male, Mexican, aged twenty-three, laborer. Entered hospital Feb. 17, 1921. Jan. 1, 1922 still under treatment for sinus in stump, but no evidence of further extension of disease. Resident in Los Angeles County one year. Admitted with gonorrhea and monarticular (left ankle) arthritis, probably gonorrheal. Urethral discharge positive for gonorrhea. Wassermann negative. March 2, 1921, evidence of pus in left ankle. Incised and drained. Apr. 1, 1921, smear of pus from ankle positive for coccidioidal granuloma. Apr. 22, 1921, left leg amputated at middle third. Draining sinus in stump.

Roentgen Examination. Destructive process proximal end fifth metatarsal, internal malleolus, and internal superior border of astragalus (Figs. 23 and 24).

CASE XI. Male, Negro, aged twenty, cook. Entered hospital Apr. 1, 1921. Died May 1, 1921. Resident in state and county one year. Admitted with moderately advanced pulmonary tuberculosis. Shortly after entry developed abscesses over right seventh rib anterior, and left sternoclavicular joint.

Autopsy. Miliary involvement both lungs (coccidioidal granuloma), also spleen, liver, kidneys and retroperitoneal lymphnodes. Left obliterative fibrinous pleuritis. Osteomyelitis seventh, eighth and ninth ribs on right and fourth on left at costochondral junction; also left clavicle at sternal end, and sacrum.

Roentgen Examination. Chest films unsatisfactory. Lumbar spine negative. Destructive process in lower left sacrum and right seventh rib (Fig. 25).

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PRELIMINARY OBSERVATIONS OF CARDIAC MEASUREMENTS IN CHILDREN*

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THIS paper is intended only to be a preliminary report on the measurement of the cardiac silhouette in children, and the work presented with a view toward arriving at some simple and at the same time accurate method of examination that could be used as a routine in any laboratory.

The child presents problems in cardiac examination, in fact, any form of examination, which do not apply in the adult. He is usually restless, and sometimes hard to manage. This is particularly true when he enters the *x*-ray room.

Because of these difficulties, orthodiagraphy and teleoroentgenography can hardly be used routinely. The little patient often will not stand or sit quiet sufficiently long to secure satisfactory results by the procedures named. Any attempt at forcible restraint in the way of bands, etc., increases the child's agitation, consumes the operator's time and usually exhausts his patience.

This agitation causes increased respiratory movement which is undesirable for careful cardiographic studies.

Our observation has been that normal respiratory movements cause comparatively little change in the maximum transverse diameter of the child's heart.

It was these difficulties, together with the advisability of having a technique which would allow for routine examination even in a busy laboratory, that led us to adopt a simple, yet for practical purposes, an accurate, procedure.

I found by making a 6-ft. teleoroentgenogram of a child amenable to instruction, and another teleoroentgenogram of the same patient at a 3-ft. distance, that the ratio of the maximum transverse diameter at 6 ft. was to that of 3 ft. as .9124 is to 1.

This ratio appears to be borne out by other practical mathematical calculations. In other words, if a given image made at a 3-ft. distance measured 10 cm., the image at a 6-ft. distance would measure 9.124 cm.

In a series of 25 children examined, each of whom incidentally had a known valvular lesion, 50 per cent of the measurements coincided exactly with the measurements made by percussion at the hands of a careful clinician. The other 50 per cent showed our measurement to vary from 2 to 15 mm.

Age	Sex	Clinical Measurement	*X*-Ray Measurement	Discrepancy, Mm.
8	F	10.5	10.5	0.0
8	M	10.0	10.9	0.9
9	M	12.0	12.0	0.0
9	F	9.5	9.5	0.0
12	F	11.0	11.0	0.0
5	M	8.5	9.1	0.6
8½	M	9.0	9.0	0.0
10	M	12.0	12.0	0.0
12	M	10.5	10.5	0.0
10	F	11.0	11.0	0.0
6	M	11.5	13.0	1.5
13	M	12.0	12.7	0.7
8	F	12.0	12.6	0.6
14	F	12.5	12.5	0.0
11	F	11.0	11.0	0.0
8	M	11.0	11.8	0.8
9	F	9.5	9.7	0.2
9	F	9.5	10.5	1.0
11	F	11.0	11.0	0.0
11	M	12.0	11.0	1.0
4½	F	9.0	9.0	0.0
11	F	9.0	10.5	1.5
5	F	9.0	9.6	0.6
12	M	11.5	12.0	0.5
....	F	11.0	10.5	0.5

The discrepancy of 15 mm. occurred in 2 cases in which the clinician was in doubt as to the accuracy of his measurements, owing to the restlessness of the children. The discrepancy in the other instances may be due to several factors: One, the known inaccuracy of clinical methods; another, the fact that the clinician makes his measurements with the child sitting erect, and his measurements are centered in the mid-sternal line. Another discrepancy noted was that greater value was

* Read at the Midwinter Meeting of the Eastern Section of THE AMERICAN ROENTGEN RAY SOCIETY, Atlantic City, N. J., Jan. 25–27, 1923.

given to the measurements of the left ventricular border and proportionately less to the right auricular border than my measurements indicated. However, the sum of the two measurements constituting the maximum transverse diameter, according to Groedel, agreed. It was noted also that while the clinician took his right auricular measurement in the fourth interspace, and the left ventricular in the fifth interspace, occasionally the roentgen examination demonstrated the extreme left border as high as the lower edge of the fourth interspace, or as low as the fifth rib, while the right auricular extreme was fairly constantly in the fourth interspace.

This range noted on the left side may be attributed to the fact that the exposures were made at different periods in the respiratory cycle.

So that, given a normal respiratory movement, not influenced by pulmonary pathology or undue excitation, the cardiac movement causes insignificant changes in the actual maximum transverse measurements of the cardiac silhouette. The main change is rather in the degree of the angle formed by the line joining the extreme right and left borders.

CONCLUSION

First: This procedure offers a simple, accurate method of securing the cardiac silhouette in children. Second: With this as with other methods of precision, the details must be technically accurate.

Discussion

Dr. Pancoast. During the investigations carried out recently, as a member of the committee appointed by the National Tuberculosis Association to establish the normal *x*-ray appearance of the chest of the child, I took advantage of the opportunity to make some measurements of the heart shadow, in case they might become useful for future reference. The children examined were between the ages of six and ten years. There has seemed to be a prevailing opinion that the right border of the heart extends relatively further to the right in the child than in the adult. This idea was held by me even during the examinations of the normal children, but after the measurements had been made and tabulated later, this did not seem to be borne out, at least not to the extent that was anticipated. The ratio of the median right to the median left measurement was found to be approximately 1 to 2.

The percentage of the shadow to the right side by orthodiagraphic measurements was as follows: Six years old, 29; seven years old, 33; eight years old, 30; nine years old, 34; ten years old, 35; with an average of about 33 per cent. At that time we were making plates of all chests at a target-plate distance of 30 in. In these children, the comparison between the heart shadow on the film at 30 in. distance and the absolute shadow as measured orthodiagraphically showed comparatively little increase in width on the film. The average of the measurements of all children of six years of age showed an increase of 17.5 per cent in the film over the average orthodiagraphic measurements. At seven years, the increase was 17 per cent; at eight years, 13.5 per cent; at nine years, 15 per cent; at ten years, 10.5 per cent. It will be noted, therefore, as Dr. Borzell has pointed out, that there is comparatively little difference between the size of the heart shadow as measured on the film or plate, even when made at so short a distance as 30 in. and the actual size as measured orthodiagraphically.

We have recently increased our target-plate distance for chest examinations to 4 ft. By using Agfa films in place of Eastman films it has been necessary to increase the time of exposure about 25 per cent only.

I think we all realize the shortcomings of our present methods of heart investigations, and that we do not obtain all the information we should. Unless we choose to adopt very complicated methods, our present technique is exceedingly crude and of little practical value. Too little attention is usually paid to the variations in measurements between stout and thin individuals. Our conception of the right ventricle is practically nil. Surely the clinician and the roentgenologist should get together and devise some plan of action that would be worth while.

Dr. Groedel. I have to thank you for the kind invitation to address this meeting and for the opportunity to discuss this very interesting paper. There is, of course, a difference between the technique of exposure for the heart of an adult and that of a child. The distance between the chest wall and the heart is less in an adult than in a child; therefore, I think it is quite the same if you take a two or a six-foot plate in children.

I am astonished to hear that you have difficulties in making short *x*-ray exposures. We had no difficulties formerly when we had good *x*-ray tubes, good intensifying screens, etc. Now, of course, all our material is so bad that we too have difficulties in this direction and we seek a method of overcoming them. For this reason we are trying now to make an

orthodiagram in every case, if possible. I have always been of the opinion that it would be better to make an orthodiagram than to take plates, because by this method we not only get the real size of the heart, but also of the lungs. I find the best measuring method is to compare the transverse diameter of the heart with that of the base of the lungs. One can judge by the two diameters whether or not the heart is normal. Regardless of whether the patient is stout or thin, in every normal case the diameter of the heart is half the diameter of the lungs, and we find there is no material deviation in this measurement.

One cannot make this comparative measurement by teleoroentgenography, because here the ratio of the size of the heart does not remain the same as that of the lungs. Thus, if the actual transverse diameter of the heart is 10 cm., you will have an error on the plates of perhaps 2 mm.; if the actual transverse diameter of the lungs is 20 cm., you will find an error of perhaps 6 or 7 mm.

In this country, with all the available good material, plates and intensifying screens, it should be possible to take instantaneous six-foot plates—perhaps eight-foot plates—and see if the diameter of the heart is not one-half the diameter of the lungs. It is really an important question. In any case, I cannot say anything against this method.

WATER-CANCER OR GANGRENOUS STOMATITIS TREATED WITH THE X-RAY*

BY J. W. CATHCART, M.D.

EL PASO, TEXAS

History of Case

INDIAN of Old Mexico, male, aged about twenty-five years. A soldier. Accompanying one of the revolutionary bands that have traversed northern Mexico for the past ten years. He crossed over the river at El Paso and on account of the seriousness of his condition was admitted to the County Hospital. He gave history of ulcer starting in his mouth one week previous following which time it had rapidly developed, as shown by Figure 1. He was referred to the *X*-ray Department and given an erythema dose of unfiltered *x*-rays, using a 6 in. back-up. This was repeated in three days, producing a second degree burn. Infection rapidly subsided and the burn healed promptly. In six weeks the patient was entirely well and was presented to the El Paso County Medical Society. He was then referred back to the Surgical Department where a plastic operation was attempted, following which there was a slight local recurrence with a septic focus in the central nervous system to which he quickly succumbed. This case is reported merely to show that the *x*-ray will control gangrenous stomatitis, as it was the only agent used other than nourishing food, the lack of which was probably the causative agent.

Fig. 1.

Fig. 2.

* Paper submitted with application for membership in The American Roentgen Ray Society, 1921.

A DEVICE TO PREVENT THE OMISSION OF A FILTER IN DEEP ROENTGEN THERAPY*

BY GEORGE E. PFAHLER, M.D.

PHILADELPHIA, PENNSYLVANIA

TO any one who is competent to do deep roentgen therapy, no arguments need be presented to indicate the importance of not omitting the filter while giving a dose of roentgen rays.

At a meeting of this society at Washington, D. C., Sept. 27 to Sept. 30, 1921, I presented a simple method for this purpose consisting of colored ribbons which hang from the filter below the tube on the tube stand and serve as indicators either of the absence of a filter or the presence of a certain kind of filter. This has served fairly well, but it is only applicable to the overhead tube stand which the operator can see easily from the observation window as the switch is closed.

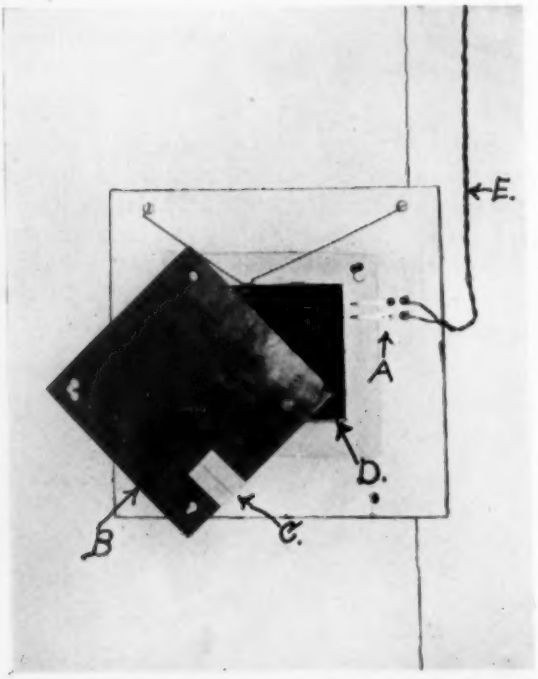

FIG. 1. A indicates the two springs which make contact with any diaphragm that is put in place without the filter, and close the circuit which rings the bell. B shows the copper diaphragm, C, the adhesive plaster on the copper diaphragm which prevents the springs from making contact, D, the open diaphragm, E, the wire to the batteries and the bell.

Since then, I found this ribbon indicator in use in several of the clinics in Europe. No mention was made to me of my being the originator. Therefore it is entirely possible that someone in Germany conceived the same idea, but this is only another argument as to its necessity and its applicability.

This ribbon indicator presupposes that the operator knows the meaning of the ribbon and will take quick cognizance of the absence of the desired filter.

More recently a number of us have found it desirable to operate our deep therapy tubes from underneath the floor or table, or from the opposite side of a leaded wall, or inside a leaded cabinet, so as to eliminate gases, much scattered radiation, and electrical dangers.

With the above arrangements a ribbon indicator is useless. Therefore, with the assistance of my mechanic, Mr. Thomas Gallon, we have developed a device which will excite a loud-ringing door bell when the filter is omitted, thus making it seem utterly impossible to continue the treatment with the absence of the filter. Its installation varies somewhat on each of our three outfits, but in principle they are the same, and any one with a little ingenuity and the understanding of electrical principles, can adapt it to his particular use.

It consists of two pieces of spring wire, each attached to the opposite pole of two dry cells, and in series with a hammerless door bell (Schwarz Electric 3″ Bell). When the filter is in place it has on its surface a non-conductor such as a piece of adhesive tape, which prevents the closing of the circuit. When the filter is removed, the springs come in contact with the diaphragm or frame of the diaphragm holder, the circuit is closed, and a bell rings, that no one can ignore.

In the installation through the side of the wall, Figure 1, we would probably never use the rays through the full open space. One could easily see the light from

*Read at the Midwinter Meeting of the Eastern Section of THE AMERICAN ROENTGEN RAY SOCIETY, Atlantic City, N. J., Jan. 25–27, 1923.

the tube, or the tube itself. When a diaphragm is put in place it instantly makes contact and the bell rings until it is removed and the filter put in place.

In the outfit which makes use of a hole in the floor, which space is covered with a mattress and where one can see nothing under any circumstances, it is so arranged that when the filter is removed the two springs come in contact with two pins connected electrically; or if a heavy lead diaphragm is in place without the filter, the circuit is closed through the lead and the bell rings until the filter is put in place.

In the Rieber outfit, which has the tube enclosed in a table, the arrangement is similar, excepting that instead of using dry cells, which after a year may become exhausted, the desired bell-ringing voltage is secured from two taps of the auto-transformer directly from the machine itself. Then the bell rings when the motor is started, if the filter is not in place.

This same idea can be applied to the ordinary tube stand, and for use with the lower voltage therapy. The batteries can be attached to the base of the tube stand and therefore moved with the tube stand. The springs can be so arranged that they come in contact with either a diaphragm or the metal support for the tube, and thereby close the circuit.

It is clearly our duty to protect our patients and to avoid unnecessary mental anguish. I would therefore urge that each one of you take some step to prevent the omission of a filter. Especially do I urge this upon those of you who are doing deep therapy.

DISCUSSION

DR. GROOVER. The device described by Dr. Pfahler is so simple that very little needs to be said about it. About all I can say is to emphasize the importance of some foolproof device for preventing accidents due to the leaving out of filters.

We should exercise eternal vigilance; and such mechanical aids as Dr. Pfahler mentions are certainly of great help.

I have used the ribbon method that he described some time ago. Incidentally, instead of ribbon we use a string with a poker chip attached, having different colored chips for different thicknesses of filter.

I think his new method is an additional safeguard, but it should not lead us into the habit of substituting our sense of hearing for our sense of sight.

A NEW TUBE HOLDER FOR ROENTGEN THERAPY*

BY THOS. A. GROOVER, M.D., A.C. CHRISTIE, M.D., AND E. A. MERRITT, M.D.

WASHINGTON, D. C.

ADVANTAGES which seem to be inherent in certain tube holders designed for use with apparatus delivering upwards of 200,000 volts, in which the entire tube is enclosed in a lead case, have led one of us (Merritt) to design and build a tube holder embodying the same principles for use with lower voltages, having certain modifications which give it a range of flexibility comparable to the tube stands commonly used for this purpose.

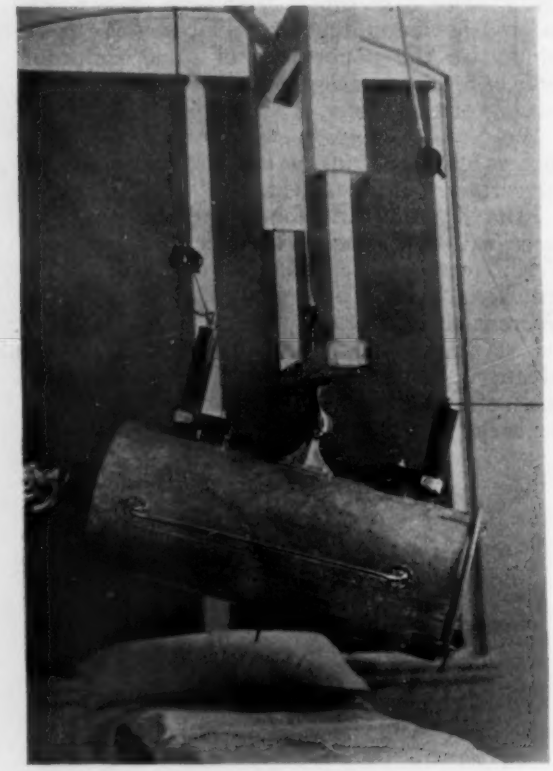

FIG. 1.

The apparatus consists essentially of a wooden cylinder 31½ in. in length with an inside diameter of 12 in. This cylinder is covered with sheet lead weighing 5 lbs. to the sq. ft. The end corresponding to the anode of the tube has a hinged door covered with lead, so designed that when closed, an aperture of ½ in. remains between it and the periphery of the cylinder, for the purpose of ventilation. The opposite end is permanently closed and lead-covered except for an aperture 2 in. in diameter for the accommodation of a connection for a fan which drives a constant stream of air through the cylinder, when the tube is in operation.

The high tension current is brought to the tube terminals by brass rods passing through paper insulators 2 in. in diameter which are provided with appropriate tube connections which also serve to support the tube in its proper position.

The insulators are held in position by felt-lined wooden clamps which permit their easy removal when necessary.

Midway between the insulators is a bronze casting having a universal joint, one member of the casting being attached to the cylinder and the other to the crossbeam of the raising and lowering device. The ball of the universal joint is 1¾ in. in diameter and permits an excursion of 45 degrees in any direction. It is provided with a locking device to hold the cylinder in the position desired. Handles are attached to the sides of the cylinder to facilitate its manipulation.

The raising and lowering device consists essentially of two wooden tunnels securely fastened and braced to the ceiling. These tunnels receive the upright members attached to the crossbeam previously mentioned. A flexible wire cable extends from the crossbeam to a pulley and counterweight and is grounded to a water-main. The counterweight weighs 80 lbs.

The device permits an up and down movement of the cylinder for a distance of 24 in.

The table for use with this apparatus must be of appropriate height and provided with roller-bearing casters. A step attached to one side of the table is a great convenience.

The apparatus described, contrary to appearances, is of easy manipulation and we believe has the following advantages:

1. It affords complete protection to the

* Read at the Midwinter Meeting of the Eastern Section of THE AMERICAN ROENTGEN RAY SOCIETY, Atlantic City, N. J. Jan. 25-27, 1923.

operator from radiation and eliminates the necessity of constructing expensive booths.

2. The patient is also protected from all radiation except such as is directed through the aperture intended for that purpose.

3. We believe that the device[1] safeguards the patient from electrical shock.

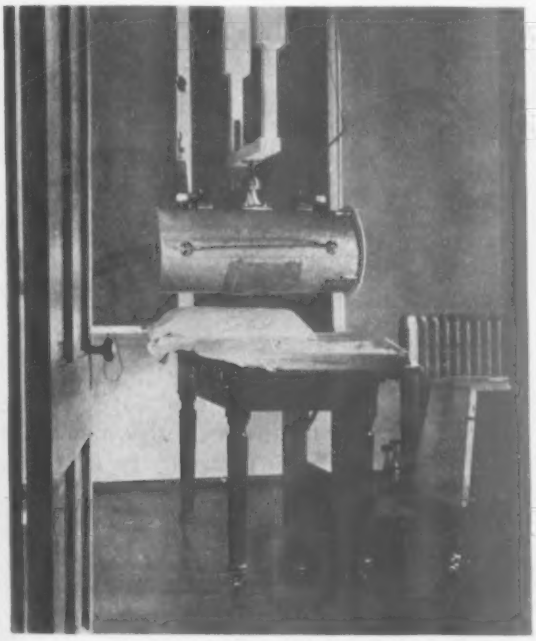

FIG. 2.

4. The risk of tube breakage and puncture is lessened.

5. The apparatus is not expensive. It can be reproduced for about $125.00 if the brass casting is made from the original mold.

DISCUSSION

DR. DARLING. Apropos of this tube stand for deep therapy work, I think I have some suggestions that would save a great deal of money.

In the first place, it seems to me that the overhead principle as emphasized by Dr. Groover is correct, and to my mind a flexible arrangement where you can point the ray up or down the table, raise or lower, is a good principle. Suspension of the weight without danger of a fall of the whole apparatus on the patient is, of course, desirable. Now all this has been very well done in a type of tube stand which is on exhibit here and manufactured by the Wappler Elec. Co. I have used that tube stand and it does away with all of this basement proposition with concrete floors for protection; it does away with lead walls and all expensive construction, and gives protection to the operator. It meets every problem, as far as I can see, that arises in the treatment of these cases. This has already been carefully worked out and you can move it from office to office. It looks to me like a permanent addition to our equipment.

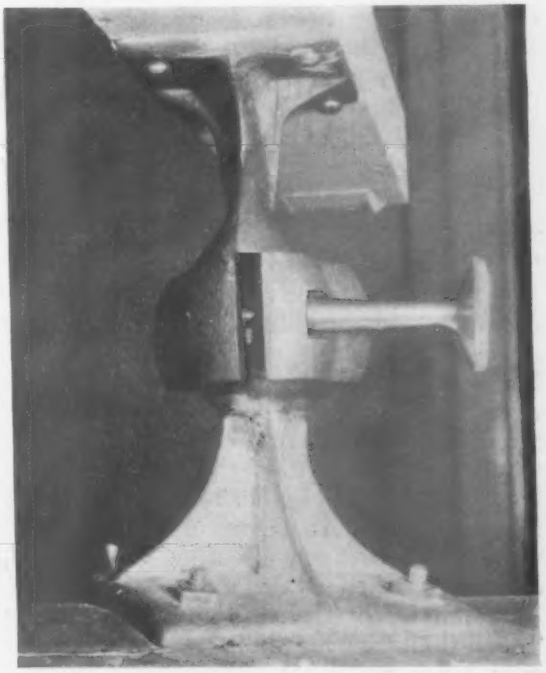

FIG. 3.

DR. GRIER. I would like to say that we have had an apparatus like this in our laboratory for seven or eight years. Some of the members have seen it. Ours differs from this only in that the box is square instead of round and a slot is cut in it which obviates the necessity of moving it—simply reach inside and move the tube. The area through which you do not wish to treat is covered by pieces of lead.

Dr. Johnston described it before the midwinter meeting of this society some seven or eight years ago and it has been published in our JOURNAL.

DR. GROOVER (closing discussion). We

[1] Since reading the above paper, we have improved the apparatus by providing a safety device which effectively prevents the cylinder from dropping in the event that the suspending cable or counterweight should fail to function. This consists essentially of a ratchet device (not shown in the illustrations) attached to the wooden tunnels which automatically prevents the cylinder from descending, except when the safety catch is held released by hand.

wish to emphasize that the apparatus we have shown is designed for the accommodation of the standard Coolidge tube. We are using it backing up a spark-gap of 9 or 9½ in.

I appreciate very well the criticism Dr. Bowen has made and I think his point is well taken. Of course, a similar objection can be made to every piece of apparatus that is controlled by a counterweight. I do not know of any foolproof way of obviating that particular difficulty.

I have overlooked the fact that Dr. Johnston had constructed a piece of apparatus embodying very much the same principles.

I think it is an advantage in doing therapy to have the entire tube enclosed regardless of the voltages used. It is quite true that the device Dr. Darling mentions embodies exactly the same features as this, but there is an important difference: that that apparatus costs something over $1,200 and this can be built for $125.

DEEP ROENTGENOTHERAPY IN THE TREATMENT OF CARCINOMA OF THE BREAST*

BY GEORGE E. PFAHLER, M.D.

PHILADELPHIA, PENNSYLVANIA

THE term "Deep Roentgenotherapy" has come to be applied to the use of roentgen rays produced by voltages of over 100,000, and generally in the neighborhood of 200,000. Therefore it is often referred to as "High Voltage Treatment." Such high voltages produce rays of shorter wave-length. Generally the effective wave-length is in the neighborhood of from 0.15 to 0.18 of an Angstrom unit. Formerly we worked with an effective wave-length of about 0.22 to 0.23 of an Angstrom unit. As a matter of fact, we have been doing "deep therapy" for about twenty years, or ever since we have successfully treated deep-seated disease, and especially deep-seated malignant disease.

We have, however, made great improvement, because the newer rays are more penetrating and the newer apparatus and the new technique enable us to deliver to the deeper tissues a greater percentage of the surface dose. Therefore, without producing a dermatitis we are able by skillful technique to produce a destructive effect upon cancer in the deeper tissues without destroying the overlying skin. It must be borne in mind that this is only a relative condition, and that in any given dose the greatest absorption and the greatest effect are in the surface tissues. The deeper values are obtained chiefly by cross-firing, but in such cross-firing, skill is necessary not only to deliver the desired quantity to a given point, but to avoid delivering too much radiation at any point where the rays are crossing, and thereby producing a deep-seated necrosis, perhaps in normal tissue.

These high voltage machines require also the greatest caution with regard to the electric dangers. One must not be misled by the technique seen in some of the leading clinics of Europe, where one can see used a focal skin distance of 23 cm. In such instances a coil is being used, and not one of our high voltage transformers. The coil will give a serious shock, but probably nothing more. On the other hand, if a spark leaps from a transformer to the patient, it will likely produce death, because of the large volume of current which it will draw.

Probably the best means of protection from the electric dangers is to have a lead wall between the patient and all wires, including the tube. The next best arrangement is probably a complete insulating cover over the patient, such as the opaque rubber, which not only protects from accidental current, but from stray rays.

Your President has asked me to present a paper upon this subject of carcinoma of the breast and to call your attention to some of the dangers in this deep therapy work, not taking for granted that these things are well known and always remembered. Deep roentgenotherapy is no child's play, but requires a thorough medical knowledge of diagnosis, pathology and

* Read at the Midwinter Meeting of the Eastern Section of THE AMERICAN ROENTGEN RAY SOCIETY, Atlantic City, N. J., Jan. 25–27 1923.

clinical medicine; a knowledge of electricity and physics; skill in radiology, and a deep sense of responsibility; for one can be so cautious as to accomplish nothing, in which instance one may be throwing a life away, or at least throwing chances away. On the other hand, one can be so bold or reckless as to cause serious damage, and perhaps death.

In the treatment of carcinoma of the breast we have a more difficult problem than in the treatment of carcinoma of the uterus, because there is less chance of cross-firing. In dealing with the uterus we have the diseased tissue located practically in the center of an oval body, and by careful measurements and skill one can deliver sufficient radiation into the diseased organ to destroy the cancer cells. In the pelvis, one can either obtain a homogeneous radiation as recommended by Dessauer from the four surfaces, or one can use several fields anteriorly and posteriorly, so as to cross specifically on the diseased tissue locally, as recommended by Wintz.

In carcinoma of the breast, the disease is not centrally located, excepting the metastasis which may have reached the mediastinum. The local tumor is situated under the skin, but at one side of an oval. Therefore one must deliver the greatest possible relative depth dose through the mammary region. Then one must supplement this by the radiation from the axillary portal of entry and from the posterior surface of the chest, sufficient to make a total of about 120 per cent of an erythema dose.

In each instance, the rays must be directed toward the deeper portions of the breast tumor. In many instances it will be impossible to deliver sufficient radiation throughout the tumor. Then one must supplement the roentgen radiation by the insertion of radium needles or emanation tubes. These indications will also apply to the tumor masses in the axilla and the supraclavicular regions. The axillary and supraclavicular metastases are usually nearer the surface than the tumors in the breast, but unfortunately, there is even less chance for cross-firing. Therefore all three of these areas need great relative depth values.

It is my custom at present to use rays having an effective wave-length (Duane) of about 0.17 Å, produced by about 200 to 210 kv., 62 cm. distance, 4 ma., with a filter of 0.5 mm. Cu + 2 mm. glass + 25 mm. mattress. With these factors on one machine I obtain an erythema dose in sixty minutes (or seventy-five minutes as a maximum toleration dose).

The treatment is given in my private laboratory; and therefore, to avoid too much constitutional effect on the patient, we give one such dose, as a rule, on alternate days. Four portals of entry are used: one through the mammary region, one through the axillary, one through the supraclavicular region, and one through the posterior thoracic region. This can be repeated once at the end of six weeks.

With this deep therapy I have seen better results than have been obtained by the lower voltage treatment. I will refer to three illustrative cases, all of which are records of stout patients in whom it is well known that the disease spreads rapidly and is more difficult to control. Stout patients offer also more difficulties to the radiologist, because of the deeper distribution of the disease. All three of these patients had advanced disease which could not be expected to disappear with the lower voltage treatment.

Case I. Female, aged forty-nine, was referred on July 29, 1922, by Dr. E. H. Bainbridge and Dr. E. S. Sheldon, for treatment by high voltage *x*-rays.

One year previously, the patient had noticed a tension in the right breast, and felt a lump the size of a walnut. The breast continued to get larger until the entire breast was indurated and tender. She had palpable metastases in both the right axilla and the supraclavicular region. Dr. Bainbridge, by *x*-ray examination, found metastases in the lungs.

Our *x*-ray examination showed thickening of the mediastinal tissues and pulmonary infiltration at the base of the right lung, which we believed were metastatic carcinoma.

She was given a dose of rays over the right mammary, the right axilla, the right supraclavicular region, the right chest posteriorly, and the left axilla in which

the rays were directed toward the mediastinum, within a period of two weeks. Such a course of treatment has been repeated three times to date. Each dose consisted of 200 kv., 4 ma., 60 min., with a filter of 0.5 Cu. 2 mm. glass × .25 mm. mattress at a distance of 62 cm.

On Nov. 1, 1922, we introduced 20 radium needles of 10 mg. each into the tumor tissue and into the nodules in the axilla.

The general breast is now soft. The tumor area is contracted to about 25 per cent, is freely movable, and is probably fibrous tissue. It is almost impossible at this stage to decide whether the remaining tumor tissue is only fibrous, or whether there are remaining some carcinoma cells; and for this reason, if there is no reasonable objection, the breast had better be removed. In one such case we found a few cancer cells remaining. In another we could find no cancer cells remaining, and all the diseased area was changed to fibrous tissue.

The dense tissue in the lower portion of the right lung which was present before beginning treatment has now become distinctly fibrous, and the general lung area is contracted. Whether this was originally cancer tissue which now has become fibrous, or whether it was originally a fibrous process which was further increased by the radiation, has not yet been determined.

As a whole, we believe the results are better than those we have obtained with lower voltage treatment.

Case II. Female, aged thirty-nine, referred Sept. 15, 1922, by Dr. R. H. Milwee of Dallas, Tex. About a year previously the right breast was bruised accidentally. It became "black and blue" following the injury. About a month later a tumor developed, which grew progressively larger until the entire breast was tumorous, with tumor masses in the axilla about 4 cm. in diameter. There were small palpable lymph-nodes in the supraclavicular region, and abnormal infiltration in the upper mediastinum.

Since then, the right mammary, axillary region, supraclavicular and posterior right chest have each been exposed three times, and the left axilla once, to the following dose of high voltage *x*-rays: 200 kv. × 4 ma. × 60 min. at a distance of 62 cm. through a filter of 0.5 mm. Cu. × 2 mm. glass × 25 mm. of mattress, with the result that no palpable malignant disease is found.

This is a better result than I have seen in such an advanced case before.

Case III. Female, aged forty-seven, was referred to me Jan. 13, 1920, by Dr. Harry Deaver. In May, 1919, the patient had a small nodule removed from each breast. These were found to be malignant. Therefore a radical operation was done on the left breast in June, 1919. Because of severe shock following this operation the right breast was not removed until Dec., 1919.

When she was referred for *x*-ray treatment she had palpable supraclavicular glands, and disease in the upper mediastinum radiating outward from the roots of the lungs, which we believed was metastatic carcinoma.

Within six months she was given five courses of low voltage *x*-ray treatment, and all palpable disease had disappeared. On June 11, 1921, an *x*-ray examination of her chest showed no evidence of disease.

On Oct. 17, 1921, Dr. Deaver sent the patient back for treatment because of a nodule at the junction of the upper ⅔ and the lower ⅓ of the scar, and swelling of her left arm, and increased firmness in the left subcoracoid region. The mediastinum remained clear. Treatment with 90 kv., 5 ma., 40 min. at a distance of 40 cm. through 6 mm. Al. filter through the mammary, axillary, and supraclavicular region, and a double dose over the nodule caused a complete disappearance of the evidence of recurrence. She remained well until Apr., 1922, when she began to have pains in her back. *X*-ray examination of the spine and pelvis showed undoubted metastatic disease of the 1st and 4th lumbar vertebrae, and also of the iliac bones on each side. On account of general discouragement no treatment was given until June, 1922, when the disease was found increased. A brace was made to support her spine. The entire spine and pelvis has been treated four times since then: 200 kv., 4 ma., 60 min. at a distance

of 62 cm. with a filter of 0.5 Cu. × 2 mm. glass × 25 mattress over each area. The disease areas have recalcified, and her general health is good, and she has increased in weight. It would seem utterly impossible to have accomplished such results in such a stout woman with the older type of radiation.

I am thoroughly convinced that we have in our hands increased power which we must learn to use skillfully.

DISCUSSION

DR. STERN. I was very much interested in Dr. Pfahler's paper on the high-voltage treatment of carcinoma of the breast.

I think that at this minute we are still up in the air as far as the proper technique is concerned. I have spent the last fourteen months in trying to come to some conclusion as to what is the best technique, and I still do not know.

When I returned from abroad, after visiting a number of clinics and listening to some of the wonderful results reported, I thought I would try in succession, the various techniques suggested, and decide for myself as to the best one to follow. The first I tried was the one I saw in Freiburg. They use 200,000 volt current 1 mm. Cu. and 2 mm. Al. filter at a distance of 50 cm. Their erythema dose is four hours. Fields of exposure, one large field from the front and one from the back. I tried this on an old lady of eighty who had one of the most malignant carcinomas I had ever seen. Most of these cancers in old women are of the scirrhous type that do not show much malignancy. This was an unusual case for that reason. Within about two weeks after the cancer was discovered it practically doubled in size; it metastasized a little further up and went under the arm. She was treated in Washington for some time with what I considered very efficient low voltage treatment. In spite of this, it began to grow rapidly until it reached a considerable size. When I first saw her she had a little bronchitis and the question came up as to whether we should wait with the treatment until the bronchitis disappeared. As some of these cases of old chronic bronchitis take a long time to disappear, and her condition seemed very serious, I decided that she had better be treated as soon as possible. The immediate result I thought was very satisfactory; the tumor practically disappeared. Shortly after the treatment I found that there was a very decided congestion on the side that was treated. This spread until very large parts of both lungs were involved. We do not know whether we were dealing with a metastasis or whether the treatment set up an intensive pneumonia which finally carried her off. You must realize that when you get 110 per cent to 120 per cent into the growth you will probably get near 100 per cent on the pleura, a dose which may set up a decided inflammatory condition.

The next technique I tried was with the use of ¾ mm. zinc and 2 mm. Al. filter at a distance of 50 cm. with 3 ma. Under these conditions my erythema dose is two hours. Here I also used two large ports of entry front and back. This patient also did well, but the treatment was again followed by a marked congestion of the lungs on the side treated. This remained fairly well localized. Keeping the pleura in mind, we decided that we were probably dealing with a pleurisy with effusion; puncturing confirmed this and after withdrawing the fluid the patient did very well. Of course it is very difficult for us to decide whether the pleurisy with effusion was due directly to the treatment or whether it was merely co-incidental. I personally feel that the treatment was largely responsible for it. In other cases I used the technique Dr. Pfahler warned you against—getting 23 cm. near the tumor. I think you can get as near as this and still keep every part of your tube at a safe distance from the patient. It is only a question of proper protection to the patient and careful adjustment of the tube holder. In working at this short distance you can take in only rather small fields. Hence the treatment is best adapted for older patients with localized growths and without glandular involvements. Many of these patients did very well indeed. There was a complete disappearance of the tumor without complications. This technique has the additional advantage of requiring considerably less time, thereby minimizing the amount of constitutional disturbances which in older patients may be rather serious. There is no doubt that with the higher voltage technique we have something at our command which enables us to get our required percentage of depth dose, which with our low voltage treatment in many cases was practically impossible. As to the best technique to adopt in the treatment of these cases, it is still rather undecided. At least I have personally not come to any definite conclusion. Probably the best thing to do is to decide each case upon its individual merit and choose the technique that will best answer our purpose in that particular case.

DR. SITTENFIELD. This paper on carcinoma of the breast has interested me greatly, inasmuch as I had the opportunity of presenting

to the Clinical Society of the District of Columbia at Washington, two months ago, a report of 114 cases of carcinoma of the breast treated with the high voltage technique within the past two years and four months.

What Drs. Pfahler and Stern have said about technique is perfectly true, though there is no one fast and set rule that can be applied to every case of cancer of the breast. In thin persons, for instance, where the tumor is situated 3 or 4 cm. under the surface of the skin, one large field, 24 cm. square at a high focal distance (and by high focal distance I mean 80 to 100 cm.) will be efficient. In another case it may be necessary to use four fields—anterior, posterior, axillary, and supra-clavicular—at 40 to 50 cm. focal distance.

I have felt of late, however, and have discussed it with my colleagues, that I am not quite satisfied that one intensive dose does the trick. I have felt that it was necessary to administer as much as the skin can tolerate, from 100 to 150 per cent of a Skin Erythema Dose at one session. By one session I do not mean one eight- or ten-hour treatment in one day. I mean radiation for about two hours daily over a period of from four to eight days. Daily examination of the blood will show that there has been considerable damage done to the cells and it is therefore not wise to repeat the second dose within six weeks. After that the dose can be repeated, and a third dose after a lapse of three months, if necessary. I have done this within the last nine months and I am much better satisfied with the outcome.

Perhaps it would be interesting to point out that we are dealing constantly with different types of carcinoma in the breast according to their clinical and biological evidence. It is not fair to state that we have treated 114 cases of carcinoma of the breast as one class unless something is said about the group and classification of these cases. In one group the tumor may be localized in the breast and remain local in the breast for some time, and it may be years before it metastasizes and becomes very malignant. This type will respond favorably to radiation or surgery. In the other type we have tumors of the breast which metastasize very rapidly either into the axillary, supra-clavicular or as Handley states, into the pectoral fascia.

We are dealing here with two different types of cancer. This is important to bear in mind because we do not get the same results in one type as in the other. First of all, the clinical and biological malignancy of the lesion has everything to do with the result obtained. In the cases described as Group 2, where the lesion has already spread to axillary and supra-clavicular regions, I am afraid that radiation or surgery is not going to benefit this type of patient to a very great extent. In order to meet this classification and to administer treatment accordingly, one must adopt means and methods best suited to administer 300 to 400 per cent of a S.E.D. to the lesion itself. At times it is essential to use a paraffine block 3, 5, or 7 cm. over the surface of the skin in order to treat that lesion as a deep-seated one, and in this way to get as much from the anterior part of the chest as from the posterior field. At other times it is necessary, in order to increase secondary radiation, to use a water bag or an ox-bladder filled with water to obtain a better absorption coefficient.

In other words, we must get away from the former fixed idea that one carcinoma dose will do for every case. It is absolutely necessary to improvise radiation technique in every individual case to fight any one type of carcinoma of the breast.

Dr. Pirie. When this high-voltage treatment came in and we got first information on it, I think the statement was unfortunate that 112 per cent of an erythema dose was the dose with which to kill cancer. Dr. Sittenfield had absolutely contradicted that, and I am glad to hear it. I contradict it myself. I do not say that 112 per cent of an erythema dose will not kill cancer, but there are many which it will not kill. In one case I have given five erythema doses and it did not kill the cancer.

We had yesterday an example of the difference in susceptibility of mice cancers to *x*-rays. Certainly the same is true of human cancer; and we must work out a technique that will kill every one. If a cancer is supposed to be killed by 112 per cent of an erythema dose, I do not see why it should not be killed with five erythema doses as well. The patient will stand five erythema doses just as well, and it is perfectly safe to overdose a patient.

The systemic effects are a great drawback. Dr. Pfahler mentioned when he was giving four areas that he treated one above the clavicle. I would like to mention an experience I have had showing the systemic effect. I had an old lady with carcinoma of the glands above the clavicle and I treated her with anterior and posterior applications. She stood the erythema dose quite well. When she came in for her next series I thought I would get better results by aiming the rays down. That direction sent the rays right through the body, with the result that she was intensely sick. This shows the effect of raying a large part of the body in comparison with a small part of it.

An observation on the blood may interest you. A patient had his blood count done immediately before one hour's dose; he had 635,000 white blood cells. At the end of the hour of treatment another blood count was made and it was found that his white blood count had dropped from 635,000 to 135,000. Later on it dropped down to 13,000.

As to the question of divided doses, I think that until we know our technique we shall have to go on with divided doses.

Dr. Groover. About two years ago we called attention to certain lung changes which we had observed in treating patients for breast cancer. At that time we were using the following technique: 5 ma. current, 9 in. spark gap, 12 in. distance, and ½ mm. Cu. and 1 mm. Al. filter, with exposure time of three hours. We stated at the time that in many cases we got a pretty severe skin reaction which, however, caused no serious inconvenience, but we were impressed with the regularity with which these lung changes appeared.

I merely wish to state at this time that we have abandoned that technique for that reason. We are now using the higher voltage apparatus, but have not used it a sufficient length of time to check up on the lung changes. However, we are thoroughly convinced that we can put a lung out of commission with much lower voltages.

I am very glad indeed to hear the men sound a note of warning as to the dangers of this so-called intensive treatment. I think that we should be cautious in the matter—not cautious to the point of cowardice, because we should remember that we are dealing with an otherwise hopeless malady, but we should at least attempt to balance our dosage to the patient's tolerance, which is not necessarily a question of skin tolerance.

Dr. Warren. Perhaps a word from the experimental side would be of value at this stage in the discussion. Most of our work has been done in California under Whipple, who has been studying intoxications of the nonspecific type. A discussion of the things which cause the intoxication following radiation would not sound well here.

One of the things we are continually concerned with is the intoxication following treatment of tumors with radiation. One of the chief symptoms which brings the patient with a tumor to you is cachexia. This is the result, supposedly, of degeneration of certain portions of the tumor which produces intoxicating substances. These bring about the condition in the body known as cachexia. If you radiate the patient and destroy the tumor, you throw more of these intoxicating substances into a circulation which is already overtaxed by these substances. You intensify the processes already going on, and as a result the patient becomes quite sick. A patient who has a carcinoma which is well advanced is quite susceptible to a very small increase of these substances, and therefore some of these effects are shown immediately. Other patients who are not so susceptible may not show these effects until degeneration of the tumor is well under way. Certain experimental intoxications are produced readily in dogs by radiation. If you give 350 ma. min. over the abdomen diffusely (we used 95 kv., distance of 10 in., using 2 mm. Al.) these dogs die on the fourth day. The symptoms start on the second day. This has been found to be constant in most of the series of animals available. As you go lower in the vertebrate scale the animals are more resistant. We thought this was due to the fact that the intestinal epithelium was highly organized and therefore less sensitive. The intoxication is explained upon the basis of the widespread destruction of the crypt cells in the intestinal epithelium. This destruction was very sharply limited to the small intestine from the pylorus to the ileocecal valve. This acute reaction to radiation can be found microscopically to start two hours after radiation and has been traced through up to the time of death at the end of four days. It is accompanied by a bloody diarrhea and prostration. Chemical and other investigations need not be discussed here but there is evidence that a profound tissue destruction has occurred. This is brought out on histological and anatomical study. (Warren & Whipple, *J. Exp. Med.*, 1922.)

Yesterday quite a bit was said about the destruction of capillaries by radiation. I do not think this is truly a primary radiation effect. In the first place, after a tumor has been radiated, the epithelial cells are killed. If you kill tissue in any portion of the body the pathologist will tell you that an ordinary inflammatory reaction will be brought about. The tissue coagulates and this brings about a hemorrhage in that region by rupture of the capillaries. Fibroblastic tissue is thrown out and the tissue is repaired. The same thing probably happens in the tumor. I do not know that this is strictly true in tumors but in our series of studies on animal tissue this is decidedly true in normal tissues. The intestinal lesions which can be produced with great regularity in dogs show thousands of small capillaries in the villi which are ruptured and thrombosed, secondarily to the destruction of the epithelium by the radiation.

There is another reason to suppose that the

capillaries are not primarily influenced by radiation. The capillaries, fibroblastic cells and white blood cells are necessarily resistant to digestion. In all tissue repair these cells are concerned with migration into areas which have been destroyed, and which offer unfavorable environments for growth and life. These cells, therefore, must remain in the presence of degenerating tumors and injured areas and repair these areas. Antolysis studies have shown that these same cells are the most resistant in the body, and radiation seems to have no influence upon their rapidity of digestion or disintegration (Warren & Whipple—ibid).

Other cells, sensitive to radiation have been shown to autolyze much more rapidly than unsensitive cells.

With reference to repeated dosage, we have had several interesting leads. I am surprised that no one mentioned the article by Kingery (*Arch. f. Dermat. & Sypb.*, 1920). A lot of these things get lost in the literature. He conceived the idea that the radiation effects decreased in accordance with the mass law. Therefore, if he repeated the dosage at a certain definite interval he could keep up the "saturation dose," in the tumor or skin. I say "saturation dose" with quotation marks because that is a poor name for the effect produced. He found that 50 per cent of an erythema dose could be repeated every three and a half days without an erythema. Obviously the skin is tremendously more resistant than the intestinal epithelium. Such factors as latent effects complicate the matter still more. One erythema dose in the dog is 75 ma. min., 95 kv., 2 mm. Al. filter, distance of 10 in. from skin to target. In human beings, using the same machine, 50 ma. min., under the same condition, was found to be an erythema dose. 75 ma. min., the E.D. for a dog definitely injures the intestinal tract. If we gave it all in one dose, 350 ma. min., over the abdomen, would kill the dog in four days. If this dosage is distributed over a period of a week, the dog will just survive no matter how the dose is divided up. If 350 ma. min. is distributed over more than a week, the effect noted will be in proportion to each individual dose only. Thus summation of the intoxication produced by destruction of intestinal epithelium could only be brought about by giving all the radiation within a week. This is further evidence in favor of the non-specific nature of the intoxication.

I was interested yesterday in the statement that in treating a tumor you should go after the ultimate tumor cells which were left after extensive radiation. We found that although you killed the dog after *x*-raying the intestines, you did not destroy all of the intestinal epithelium, but if you spread the dosage out over a period of a week or more you killed more and more of the intestinal epithelium. We thought that the intoxication after each radiation was due to absorption by the blood stream of toxic substances from the dead cells. The dog would go through the symptoms following one dose and then recover. There was no increased sensitivity or anaphylactic reaction to the second dose. It was a purely chemical phenomenon.

We have had a small amount of experience with secondary radiation. We used lead screens with a one- or two-inch aperture, square, or circular, as the case might be. Using intestinal epithelium as an indicator, we gave 7 or 8 erythema doses over this small area. The dog had a small amount of diarrhea and at autopsy there was definite ulceration of the intestine which was sharply limited to the area that was exposed to the rays through the aperture. We think, therefore, that secondary radiation which may be effective in the destruction of sensitive tissues is not a factor which necessarily has to be considered in therapy. I know there are a lot of physicists who will not agree that secondary radiation is not effective, but at least by this method we cannot demonstrate any effect in the tissues at any appreciable distance from the area which has been exposed in the primary beam.

We have had no experience whatever with the effect of high voltage radiation upon the pleura, but we have used tremendous doses at 95 kv. over the thorax and we have obtained no lesions except skin burns and changes in the white count and bone marrow. Very often those cases in which pleural fibrosis is present are complicated by carcinoma. Carcinoma is well known to produce fibrosis and also exudate in the pleural cavity. It is probable that the fibrosis noted is due to the cancer and not to the radiation. More experimental work must be done on this subject to clarify this point.

There is another consideration which I think the average man does not think of, and that is, how often he exposes the abdomen without taking into consideration the fact that his rays may penetrate through the abdomen. We have looked with great respect upon the intestinal tract, and every time there is any chance at all for the radiation, even at a great distance, to penetrate the abdominal region, we suspect—or we should suspect at least—that the intestinal tract has been injured to some extent, causing some symptoms of intoxication without producing any clinical evidences of such an injury. When a patient

has been radiated and the intestinal tract is in the field, even though very far distant, we must rule out that particular element when talking about intoxications.

DR. PFAHLER (closing discussion). I appreciate this discussion very much. I purposely made the paper brief so that we could have it. I did not attempt to discuss all the phases that might have been considered.

First, with reference to the dose: I, of course, do not think there is any fixed dose for carcinoma. Many of you have gotten the impression that in Europe these men who speak of a carcinoma dose think there is some fixed percentage of an erythema dose that will kill all cancer. I am quite sure you are wrong. At least, that has not been my observation. They simply take that percentage as a general plan of action.

I agree thoroughly with Dr. Sittenfield that we must adapt our technique and dosage to each individual case, and must consider first of all the patient's general condition and general health. We must not kill the patient while curing the disease, and for that reason, as you will see by the few cases I referred to, we do not attempt to give all the treatments in one day, but spread them over a period of ten days to two weeks. You will see by the few cases that I have referred to (and I can refer to others), that we do not attempt to cure the case by a single application. Every one has had from three to five applications over the diseased area, and so you see that we have really delivered into that tissue from three to five times the amount that we might think necessary to cure the disease. I am quite sure that in many cases we are not curing them, no matter how much we carry into the tissue. We all observe, clinically, in carcinoma, that there is a great variation, and we must meet that variation with the maximum amount of radiation that we can deliver into the diseased tissue. If we can know just where the diseased tissue is located and confine our cross-firing as much as possible to that diseased area, we will do much for the patient. But unfortunately, especially in carcinoma of the breast, we get metastasis at great distances, and at the best we cannot plan to treat further than the mediastinum in the first treatment.

Now as to the blood: We must be very careful about the blood. In every case that we treat with high voltages we start with a complete blood count, so that we know the condition of the blood at the start. If it is not up to normal, we do everything that is possible to bring it up to normal. The blood must be watched during the course of treatment because the treatment does tend to decrease both the reds and the whites. The rapid decrease to which Dr. Pirie referred is a question that has not yet been solved. Of course, he starts with an extremely high white count, and of course that will respond much more readily than normal blood.

Now as to technique: We are not using the same general technique in every case, but we should have something to start with. I gave you just a general plan of action, but by no means should you confine yourself to that. You must adapt your technique to the individual case. If you know where the diseased tissue is, and can confine your radiation to that diseased area and are sure there is none beyond, you are better off for the sake of the patient. You cannot send radiation through normal tissue without some effect on it.

With reference to lung changes: I have been studying the chests of patients I have been treating routinely during the past twelve years. I make a plate at the very beginning of treatment and make repeated plates during several years following this treatment. I have also been noticing these fibrotic changes developing in the lungs. Not in the great majority—I should say perhaps 10 per cent—but in every instance when I take this series of plates running back over several years in which I observed these fibrotic changes, I have been able to trace the beginning of it even before I gave the first application. If you look carefully, you can trace back and find the very beginning of the fibrotic change before you start. We are probably stimulating it in some way. For a time I thought the changes were a fibrous process replacing malignant disease. I do not know what it is.

I am much interested in Dr. Warren's statement that he has not observed these changes in dogs. We must bear in mind that they do not come quickly. They may come six months, a year or two years after treatment. Therefore, it may be that he has not observed the dogs long enough to get the fibrous changes. I do not think these changes should deter further treatment.

With regard to setting up a pleurisy, I will give you a single experience which I have had in the past few months. Patient was referred to me by Dr. Babcock; she was tapped on two occasions for pleural effusion, left lung, following carcinoma of the left breast, before coming to me. I made an *x*-ray examination and found further evidence of fluid. I did not want to start treatment until the fluid was removed. This was done and I made another examination, and found half of the lung area opaque. I think it was undoubtedly due to tumor tissue. I treated that patient with high voltage in the

manner which I have described. The tumor tissue has undoubtedly decreased, the patient's general health has improved, and the fluid has not recurred.

Now as to toxic effects: That is a subject we could spend a whole day discussing and then not decide. I regret exceedingly that Dr. Case did not come and give us his paper. I have been studying this subject of radiation sickness for a number of years and have had such contradictory evidences that I do not know where I stand.

I have referred to this one case before in discussion, but I mention it again because it is so peculiar. Patient was treated for fibroid of the uterus and was given 16 portals of entry at that time. During the first course of treatment she had no radiation sickness. Then she developed sickness and I finally gave her only one dose on each day. When she came back for the third or fourth course of treatment she said she wanted the treatment all in one day—wanted to be sick all in one day and get it overwith. So I gave her 16 doses, and she did not get sick a bit. How are you going to explain it? We run into such contradictory evidence all the time. Sickness does not always come from the abdomen. I have had serious radiation sickness when treating about the face where the rays were sent down through the body.

I was very much interested in the observations of Dr. Warren that ulcerations were confined to the area treated. That would indicate, in my judgment, that the radiation sickness is not due to degeneration of the intestinal epithelium, because the damaged epithelium is confined to the actual location of the rays, and therefore it is not due to any secondary effect from circulating blood changes. I know you will find in the literature that some of the European workers have assumed that the radiation sickness is due entirely to effect on the intestinal epithelium. Of course you observe epithelial changes from massive doses for carcinoma of the uterus because you are sending the rays through that area, especially where you are using large fields, but I think it is entirely wrong to assume that radiation sickness is entirely due to that effect. There must be something else we have not yet discovered.

A SIMPLE NOMOGRAM FOR THE DETERMINATION OF RADIUM SKIN DOSES

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IN a previous paper,[1] an equation was published whereby if five of the six conditions determining radium dosage—milligrams of element, time of exposure, distance of source from skin, amount of filtration, and size and shape of applicator—were known, the sixth could be calculated. The equation is

$$\text{S.D.} = \frac{0.63 \times (\text{mg.} \times \text{hr.}) \times \alpha \times \delta}{(\text{cm.})^2}$$

S.D. represents the amount of radiation falling on the skin, measured in terms of the standard erythema dose; α, a factor which takes account of the filtration; δ, one depending on the size and shape of the applicator and its distance from the skin; mg., hr., and cm. are self-explanatory. A table of values for α was published in the same paper, and tables and curves for finding the value of δ for any applicator, in a later one.[2] It remains, then, only to substitute the values in the formula and perform the indicated operations.

It occurred to the writer that a simpler means of solving this equation would be a nomogram, or chart, on which, when the points representing the known quantities were connected by straight lines, the solution would be immediately indicated. Such a chart can be constructed for an equation of this type with any number of variables, but the simplest form is for four. We may reduce the number of variables in our equation to four by combining milligrams and hours into milligram-hours, and by deciding that we will make a separate chart for each filtration factor, thus reducing α to a constant for the special case. In practice, only a few filters are used, and it is more

[1] Failla, Quimby, and Dean. Some problems of radiation therapy. AM. J. ROENTGENOL., August, 1922.

[2] Quimby. The effect of the size of radium applicators on skin doses. AM. J. ROENTGENOL., October, 1922.

convenient to have a chart for each one than to use the more complicated nomogram for five variables.

If we consider the special case of a filter of 2 mm. of brass and a few mm. of rubber, in which we are most interested, as the standard for gamma ray therapy, α becomes 0.009, and our equation is

$$\text{S.D.} = \frac{0.63 \times 0.009 \times (\text{mg.-hr.}) \times \delta}{(\text{cm.})^2}$$

The nomogram for this equation, constructed by the regular method (see "Graphical and Mechanical Computation," by Joseph Lipka) is shown in Figure 1. The scales AX, BY, AZ, and BT represent skin dose, milligram hours, distribution factor, and distance respectively. The diagonal AB is necessary in using the chart, and the dotted lines represent a solution of the equation, and will be discussed later. Figures 2 and 3 are similar nomograms for filtrations equivalent to 0.5 mm. of brass and 1.2 mm. of rubber, and 0.16 mm. of brass and 1.2 mm. of rubber (α equals 0.03 and 0.25 respectively).

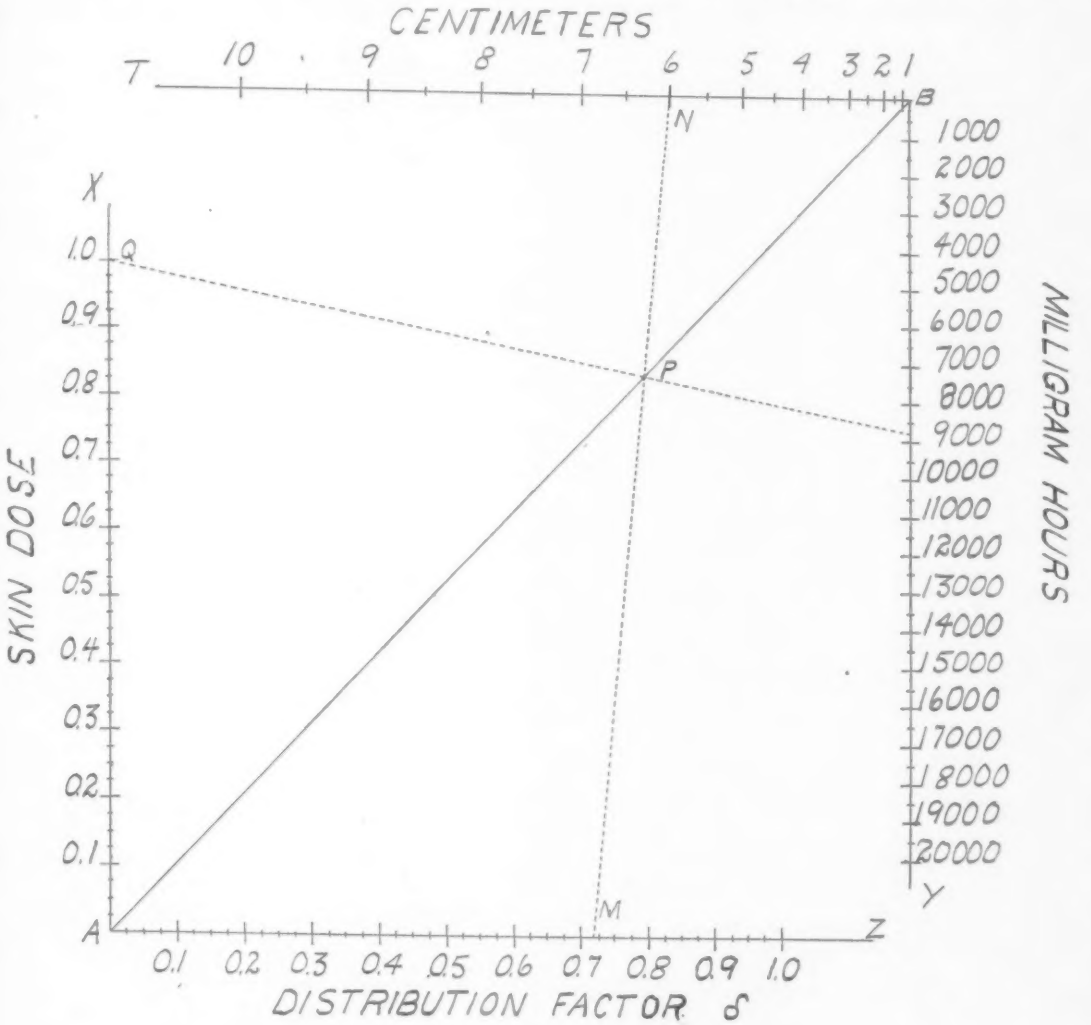

FIGURE 1

FILTER 2MM. BRASS AND 2.4MM. RUBBER

The method of using these is as follows: Three of the variables in the equation are known, and it is desired to find the fourth.

Between the values of the two known quantities which occur on opposite scales—S.D. and mg.-hr., or cm. and δ—draw a straight line. Connect the point where this line crosses the diagonal AB with the point on the scale representing the third known quantity, and extend this line to the fourth scale, which it will intersect in the point giving the desired value. A few illustrations will make this clear. Values for δ for any applicator at any distance may be found by means of the paper previously mentioned. A few of those most used are given in Table I.

1. With an applicator 8 × 12 cm., having a filtration equivalent to 2 mm. of brass and 2.4 mm. of rubber, it is desired to give one skin dose at a distance of 6 cm. What amount of radiation is necessary? The solution is indicated in Figure 1. The distribution factor, δ, for such an applicator is 0.719. The line MN joins this point on the δ scale with 6 on the centimeter scale, and intersects the diagonal AB in P. The line QP connects this point with 1 on the skin dose scale, and, extended, cuts the milligram hour scale at 8,800, which is the dose required.

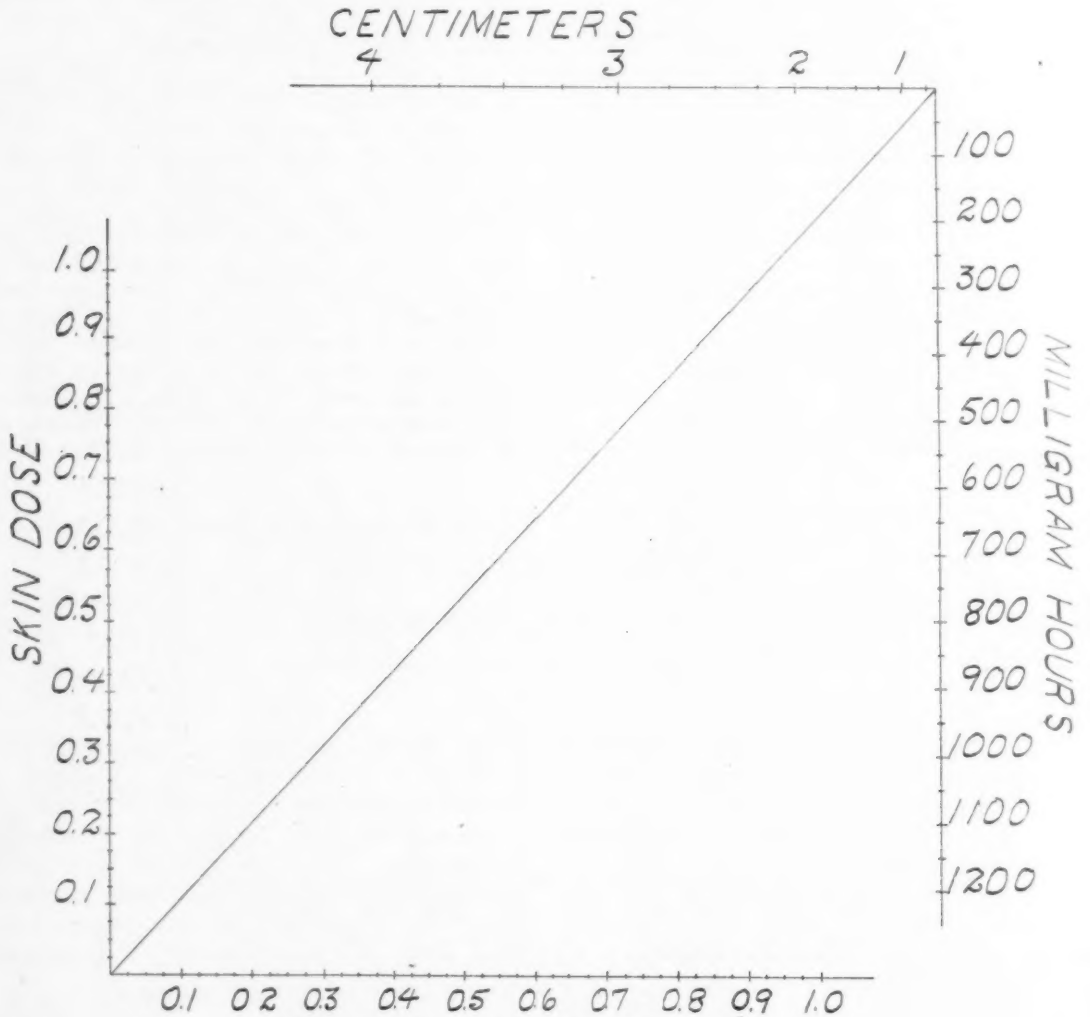

FIGURE 2

FILTER 0.5 MM. BRASS AND 1.2 MM. RUBBER

2. What will be the intensity of radiation delivered on the skin by a 4 cm. square plaque having a filtration equivalent to 0.16 mm. of brass and 1.2 mm. of rubber, when a dose of 25 mgm. hrs. is given at a distance of 2 cm. from the skin? The solution is indicated in Figure 3.

In practice it is convenient to copy these nomograms accurately to scale on a piece of cardboard or stiff paper, and use tracing paper on which to mark the index lines for solving the equation. In this way the chart itself will not be disfigured.

The accuracy of the solution obtained in this way depends on the accuracy with which the scales are made and the care with which the index lines are constructed. It should be easy to get results correct to within 2 per cent, which is much better than actually needed in radiation therapy.

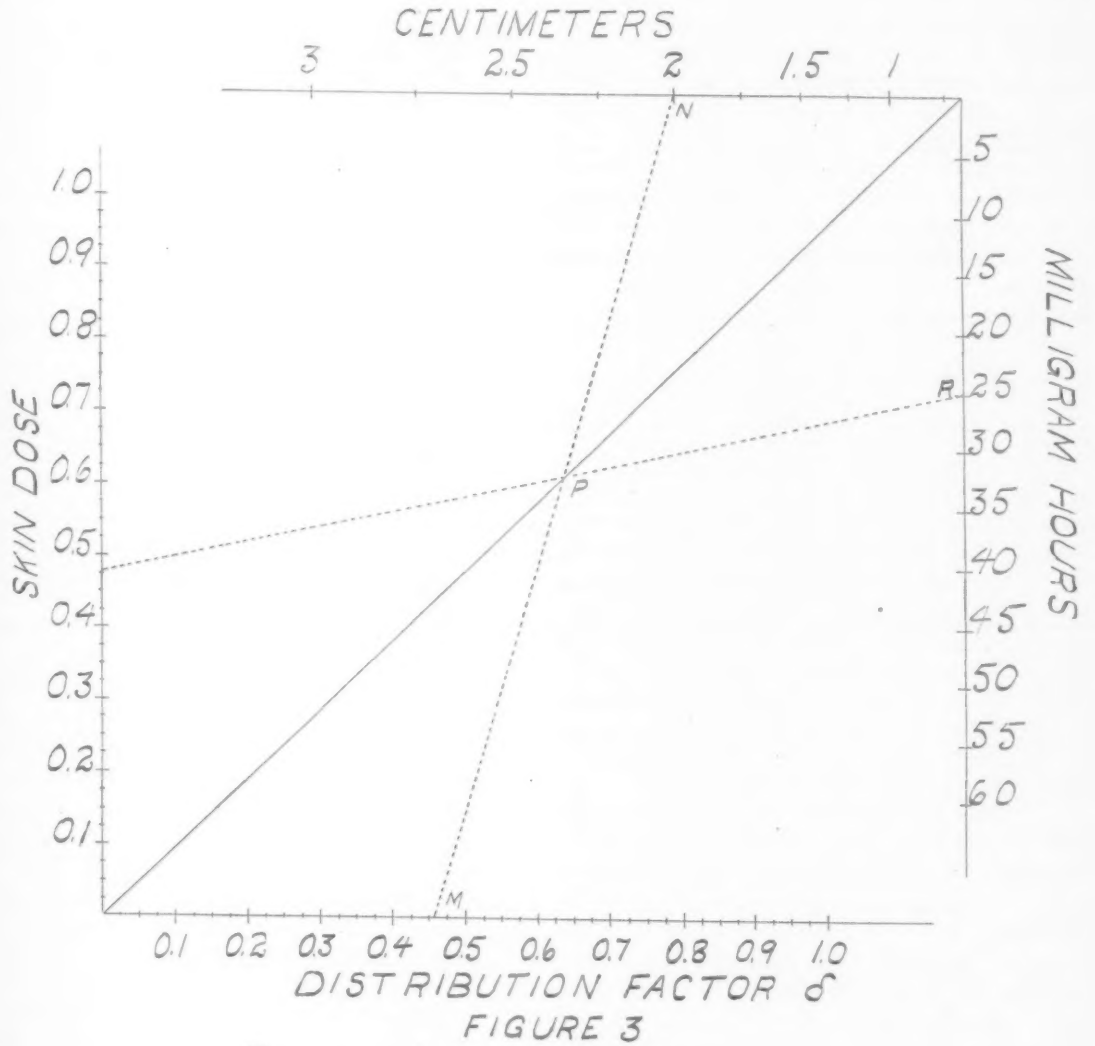

FIGURE 3

FILTER .16MM. BRASS AND 1.2MM. RUBBER

δ from the table is 0.462, and the line MN joins this point with 2 on the centimeter scale. PR joins the intercept on the diagonal with 25 on the milligram hour scale, and, extended, cuts the skin dose scale at 0.475, which is the portion of a full skin dose delivered on the skin.

TABLE I

DISTRIBUTION FACTORS FOR CERTAIN APPLICATORS AT DEFINITE DISTANCES

1. Filter 0.16 mm. Brass and 1.2 mm. Rubber

Distance, centimeters	Circles (diam.)		Squares (side)		
	2 cm. δ	4 cm. δ	1 cm. δ	2 cm. δ	4 cm. δ
0.5	0.196	0.054	0.462	0.178	0.050
1.0	0.504	0.196	0.761	0.462	0.178
2.0	0.781	0.504	0.925	0.761	0.462
3.0	0.889	0.692	0.963	0.872	0.654

2. Filter 0.5 mm. Brass and 1.2 mm. Rubber

Distance, centimeters	Circles (diam.)		Squares (side)		
	2 cm. δ	4 cm. δ	1 cm. δ	2 cm. δ	4 cm. δ
1.0	0.495	0.223	0.752	0.460	0.210
2.0	0.788	0.495	0.905	0.752	0.460
3.0	0.877	0.685	0.953	0.860	0.660

3. Filter 2.0 mm. Brass and 2.4 mm. Rubber

Distance, centimeters	Circles (diam.)		Squares (side)			Rectangles		
	2 cm. δ	4 cm. δ	2 cm. δ	4 cm. δ	6 cm. δ	4 × 6 cm. δ	6 × 9 cm. δ	8 × 12 cm. δ
2.0	0.887	0.685	0.840	0.635	0.478	0.552	0.388	0.283
3.0	0.947	0.827	0.936	0.775	0.635	0.719	0.552	0.430
4.0	0.970	0.887	0.955	0.840	0.711	0.808	0.668	0.552
5.0	0.980	0.927	0.973	0.898	0.800	0.863	0.755	0.639
6.0	0.986	0.947	0.979	0.936	0.840	0.901	0.808	0.719
7.5	0.992	0.966	0.986	0.951	0.898	0.937	0.863	0.790
10.0	1.000	0.980	0.990	0.973	0.939	0.962	0.919	0.863

ROENTGEN THERAPY IN THE TREATMENT OF NASAL POLYPI*

BY JAMES G. WARE, M.D.

SANTA BARBARA, CALIFORNIA

DURING the past two years, I have had the opportunity of treating 16 cases of nasal polypi by roentgen therapy. The results have been so favorable that I felt sure the report of a few cases might be of interest, not only to those specializing in *x*-ray work, but to the members of the profession in general.

Under certain conditions, purulent sinus inflammations will give rise to the formation of myxomata or edematous nasal polypi. They are usually associated with inflammatory changes in the sphenoid cells; less commonly with the ethmoids and maxillary antra. They usually spring from the sphenoidal ostium or the ostium maxillare, and occasionally from the middle turbinate or ethmoids. On rare occasions one may be observed attached to the nasal septum. They are rarely seen in persons under the age of puberty.

Nasal polypi are usually fibromyxomata, being composed of edematous mucous membrane, containing the usual inflammatory products. A covering of epithelium surrounds the sac and is supplied by a few blood-vessels and nerve filaments. They may be single, multiple, pedunculated or sessile. They may be large enough to fill the entire nasal chamber, or extremely small, appearing like a cluster of minute grapes.

The patient usually complains of nasal obstruction and watery discharge, or may have occasional attacks of acute rhinitis. Headaches, asthma and attacks of sneezing are not uncommon. The quality of the voice is changed, due to the obstruction of the nasal passage.

Surgical intervention is not always successful, the polypi recurring times without number.

The treatment of polypi by roentgen rays follows closely the technique employed first by Witherbee in the treatment of tonsils. The following factors are used: 3 mm. of aluminum; 8-in. sp. gap; 5 ma.; 10-in. distance; four min. to each side. Four to six treatments at one-week intervals. Rays are directed over the nose and up into the posterior sinuses, through an opening in a sheet of lead foil, approximately 2½ in. in diameter. The head is slightly turned to one side as each dose of four minutes' duration is given.

It is always advisable to make an *x*-ray examination of the antra before beginning treatment. Not infrequently nasal polypi will be associated with multiple polypi of the maxillary antra, the plates showing a marked density of these sinuses. Treatment of the nasal polypi alone will give very little relief. My experience leads me to believe that if the polypoid growths in the antra are surgically removed, followed by *x*-ray treatment, excellent results will be obtained.

CASE I. Female, aged forty. States that for the past ten years she has had multiple polypi removed from both nares on several occasions. She has had periodic nasal discharge, associated with headaches, and general feeling of malaise. Both sides of the nose are partially obstructed at this time by similar growths. Patient was given two doses of *x*-rays, one week apart. There was a rapid shrinking of the polypi. Patient states that discharge has practically stopped and that she can breath without difficulty through the nose.

CASE II. Male, aged thirty-nine. Four years ago had an infection of all the accessory nasal sinuses. Following that time has had persistent nasal discharge. Discharge suddenly stopped and patient began to complain of headaches and difficulty in breathing through nose. Large polyp formed on left side. Smaller ones were found in right nares, apparently attached to ostium of sphenoid. Were surgically removed. Discharge increased and headaches stopped. Within six months symptoms began to reappear, and polypi reformed. Again they were surgically removed. The following year his symptoms were worse than at any previous time. Examination showed large polyp in left

* Paper submitted with application for membership in THE AMERICAN ROENTGEN RAY SOCIETY, 1922.

nostril, and multiple small ones in the right. Was given four doses of *x*-rays at one-week interval, and condition began to improve immediately. Polypi have entirely disappeared and he has had no recurrence of symptoms.

CASE III. Female, aged forty-five. Referred for *x*-ray examination of teeth. In making these films, I observed that patient was breathing entirely through the mouth. Closer observation showed that a large polyp filled the entire left nostril, and was almost protruding. The right side showed no evidence of polypi, but the turbinates were greatly thickened and the septum deflected to the right. When asked if she would allow me to treat this condition in order that I might follow up my work in this line, she informed me that she had had them surgically removed on several occasions, but that they had always recurred, and that now she was taking up Christian Science. I told her that I hoped she would improve under this form of treatment, but that if she wanted to come back at any time for treatment I would be glad to do what I could for her, purely from an experimental standpoint. She returned in two months, unimproved. Four doses of *x*-rays were given. Improvement was almost immediate. The polyp disappeared and the congestion of the turbinates on the opposite side lessened. I advised her to consult a specialist to have the septum corrected, but she preferred to leave "well enough" alone.

CASE IV. Male, aged fifty-two. Presented himself as an experimental subject. Has been troubled for eleven years with chronic sinus infection, involving the ethmoies and sphenoids, associated with the formation of multiple small polypi in the upper nasal chamber. Had been operated on several times with temporary relief. Examination showed the presence of multiple minute clusters of polypi high up in the nasal cavity of both sides. Patient was given three doses of *x*-rays one week apart. Relief was rapid. The discharge was markedly increased after the first dose, but began to subside rapidly. His headaches disappeared, and his general health was greatly improved. There has been no recurrence up to this time, after a period of eight months.

The remaining cases were all of the same type. Four treatments, one week apart, are usually sufficient, but as many as six have been given. Several cases have been lost track of, but it seems probable from those that can be observed, that all will undoubtedly obtain considerable relief. It is too early to predicate the final outcome, but we hope that the results will be permanent.

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Information of interest to all readers and lists of officers of The American Roentgen Ray Society and The American Radium Society will be found on the two pages preceding Table of Contents.

HOME-MADE *X*-RAY DIAGNOSIS

So much has been said and written in the past few years about the benefits and evils of specialization in medicine that one is apt to take it for granted that the entire trend of medical thought and action has been in the direction of closer limitation of the specialties, with even further subdivision of already marked-off special fields. It is of interest therefore to detect and comment on one example of an opposite tendency; a tendency for members of various special groups to take over the functions of an already well-recognized and well-established special medical field.

A prominent manufacturer of *x*-ray equipment advertised not long since, in effect, that *x*-ray equipment is now as simple to operate as a typewriter and quite as necessary to the office of the modern physician. The invention of the Coolidge *x*-ray tube, an entirely reliable and dependable source of *x*-rays which has supplanted the temperamental gas tube of former days, and the post-war simplification of *x*-ray apparatus in general have indeed removed most of the mystery and complexity from the technical side of *x*-ray work. It is possibly quite true that an intelligent person, with the general education and the special training in physics, chemistry, and anatomy which every well-trained physician possesses, could learn more easily to make satisfactory routine roentgenograms than to type a neat letter in a reasonable length of time. It is also perhaps in the nature of things to be expected that the manufacturer of equipment should not see beyond the production of roentgenograms, since he is not concerned with better medicine, nor even, directly, with better roentgenograms, but rather with more of them.

There is, however, another and not too obscure goal beyond the roentgenograms, and that goal is diagnosis. If the aim of roentgenography is diagnosis, the question becomes, not who makes the roentgenogram, but rather who interprets it. Roentgenologists have for years voiced earnest and strenuous objection to the interpretation of *x*-ray findings by lay technicians, and not by any means entirely for selfish reasons, but rather because they felt that such a practice had a tendency to discredit their own work in the minds of the not too discriminating members of the medical public, as well as of the lay public. The very ease of operation of present-day small roentgen equipment begins to justify similar criticism of what may perhaps be called the medically-trained *x*-ray technician, the medical man who feels competent to interpret his own *x*-ray films because he has purchased an *x*-ray machine.

No criticism is intended of the man so situated that he must perforce be his own roentgenologist. He deserves all credit for his progressive spirit and his resource. Nor is it intended to criticize the surgeon who prefers to *x*-ray his own fracture cases, and who has had a sufficiently wide experience to feel perfectly capable of reading bone films. The simplified *x*-ray equipment of today enables both these classes of medical men materially to improve the quality of service they render their patients, and that is after all, the only criterion by

which any development in medicine ought to be judged.

In another and perhaps increasingly common application, the wider distribution of *x*-ray equipment has lowered the quality of service rendered the patient. I refer to the man doing a large practice in a more or less specialized medical field in an urban community with no dearth of trained roentgenologists, who for his convenience and immediate profit elects to do his own *x*-ray work. It is easy to follow the train of thought which leads to such action. The internist or the orthopedist or the surgeon finds himself increasingly busy, with more and more demands on his time, and perhaps on his pocketbook. The unavoidable delay and loss of time incurred in sending patients for examination even to a neighboring roentgenologist becomes increasingly irksome. It strikes him that he is sending out an average of three or four cases a day. He has been in the habit of viewing *x*-ray films with his roentgenologist for years, and feels that he has picked up enough knowledge of interpretation. It is pointed out to him that the apparatus necessary to make his own plates would not take up a great deal of room, that a convenient closet can be made into a dark room, that his office nurse can be taught technique, and that the equipment "will pay for itself" in six months, more or less. Looking at it in that light the wonder is that every man in large practice does not install his own roentgen equipment. And if he looked on medicine solely as a business, perhaps he would. Certain it is that this line of reasoning appeals to many men who otherwise remain strictly within the limits of their special field; to internists who, for instance, would not think of doing their own tonsillectomies.

Such a course, attractive as it may seem, has two serious pitfalls. The first and most obvious is that the internist or the orthopedist or the surgeon does not really know enough about *x*-ray interpretation to do justice to his patients. Those examined by him are *x*-rayed, but they are not given the full benefit of an *x*-ray examination. Further, this situation is not one that is apt to improve materially since, the man who has thus taken over the functions of his roentgenologist is almost certainly too busy with his regular and proper work really to learn roentgen interpretation. Such a course would imply a willingness and an ability to take his mind and his time away from the work to which he has devoted years of thought, and focus his attention on another and alien specialty.

However, granting this adequate and unusual knowledge of roentgen interpretation, home-made *x*-ray diagnosis is dangerous in another and more subtle way. However well we may have been taught to maintain an open mind during the progress of an examination, however often we may have been warned not to make a snap-shot diagnosis and then seek to confirm it by further examination, it is almost impossible for the clinician to avoid forming a definite opinion from the history and the physical examination, and it is more than human for him not to hope that other and later evidence will tend to support him in his guess. An *x*-ray examination, in any obscure condition, to be of real value, should be a roentgen consultation, and should have all the scope and all the honesty of any other consultation. If it is allowed to become either a conscious or an unconscious effort to confirm a clinical impression, it has already lost much of its value. The suggestion that such molding of *x*-ray findings to accord with the clinical picture is of frequent occurrence, does not by any means imply a lack either of honesty or ability on the part of the interpreter. It is obvious that this will not occur in cases where the *x*-ray evidence is clear-cut and convincing and of a positive character. The shadow of a kidney stone, for instance, or of a group of gall-stones when clearly shown, and proved to be such, admits of no misinterpretation. Similarly, advanced tuberculosis, fluid in the chest, and advanced bone pathology all give clear-cut *x*-ray indications too frank to be disregarded or greatly distorted by any one trained in roentgen interpretation. The temptation to pervert the evidence, or rather to allow the clinical bias to play a part in dictating the interpretation of *x*-ray findings occurs only in the border-line conditions where men might honestly

differ as to the interpretation to be put upon a film or a fluoroscopic examination. Frequent examples are early lung changes, gall-bladders which are capable of *x*-ray demonstration but which do not show stones, early joint and spinal disease, and minor changes in sinus densities. In each of these instances, if the clinician makes his own *x*-ray examination he is rather prone to bend the interpretation to fit his clinical impression, and then, possibly in all honesty, to say that the clinical diagnosis was confirmed by *x*-ray examination. How ridiculous and how unfortunate for the patient.

Another and perhaps the most common field for this unfortunate type of interpretation is the roentgen surveys of the gastro-intestinal tract. Here much of the evidence is necessarily indirect, and when so, its value depends almost entirely upon the experience and ability of the roentgenologist. If he is to arrive at true conclusions it is highly desirable that he conduct his examination without any clinical bias whatever. If, when he has finished, his report confirms the impression gained from the history and the physical and laboratory findings, well and good; the case is made so much stronger. If, on the other hand, it quite fails to accord with these impressions, this disagreement should give the clinician pause; should lead him to scrutinize with due care his own findings to see whether they justify him in disregarding the roentgen evidence.

If the *x*-ray examination, then, is to be anything more than a gesture, if its object is really to throw additional light upon the obscure and difficult case, if it is to do something more than impress the patient with the completeness of the doctor's equipment, it seems highly desirable that it should be, at least in all except the simplest cases, truly a roentgen consultation conducted by a competent specialist who devotes his entire attention to roentgenology, and who has the courage and ability to give a worth-while opinion based upon *x*-ray evidence alone, and not biased either consciously or unconsciously by laboratory or clinical factors.

Charles D. Enfield.

Louisville, Ky.

REDUCED RATES

The attention of roentgenologists living on the Pacific Coast is directed to the following letter from the Chairman of the Trans-Continental Passenger Association:

Dr. A. C. Christie, Business Manager,
American Roentgen Ray Society,
Washington, D. C.

Dear Sir:

Referring to the question of excursion fares from Pacific Coast states for the next meeting of the American Roentgen Ray Society, Chicago, Illinois, September 18–21, 1923:

The question of fares for delegates from Pacific Coast to conventions and meetings to be held in eastern territory between the latter part of May and the middle of September, 1923, has been given consideration and it has been definitely determined to authorize the sale of summer excursion tickets at fares slightly higher than the one-way fare for the round trip.

The fares which will apply from principal points are as follows:

To Chicago

From San Francisco, Calif.	$86.00
Los Angeles, Calif.	86.00
San Diego, Calif.	86.00
Portland, Oregon	86.00
Seattle, Wash.	86.00
Spokane, Wash.	81.00
Tacoma, Wash.	86.00
Vancouver, B. C.	86.00
Victoria, B. C.	86.00

Fares shown herein are subject to change without notice.

The summer excursion tickets will be on sale May 15 to September 15, inclusive, limited for return to October 31, 1923. Stop-overs will be permitted at all points on the going and return trip.

Summer excursion fares and arrangements will be available to delegates and visitors attending your convention.

Attention is invited to the fact that these fares are lower than the general convention basis and should encourage and stimulate travel to your convention as well as general travel.

It is recommended that delegates to your convention confer with their home

ticket agents who will be able to give them more detailed information regarding fares, routes, attractions, etc.

In addition to the above letter, further announcement is as follows:

To all parts of the United States and Canada, except the Pacific Coast States, a reduction of one and one-half fare on the "Certificate Plan" will apply for members attending the meeting of the American Roentgen Ray Society to be held at the Congress Hotel, Chicago, Illinois, September 18–21, 1923, and also for dependent members of their families.

The following directions are published for the guidance of members who wish to obtain the reduced rates:

1. Tickets at the regular one-way tariff fare for the going journey may be obtained on any of the following dates (but not on any other date): September 14–20. Be sure that, when purchasing your going ticket, you request a CERTIFICATE. *Do not make the mistake of asking for a "receipt."*

2. Present yourself at the railroad station for ticket and certificate at least thirty minutes before departure of train on which you will begin your journey.

3. *Certificates are not kept at all stations.* If you inquire at your home station, you can ascertain whether certificates and through tickets can be obtained to place of meeting. If not obtainable at your home station, the agent will inform you at what station they can be obtained. You can in such case purchase a local ticket to the station which has certificates in stock, where you can purchase a through ticket and at the same time ask for and obtain a *certificate* to the place of meeting.

4. Immediately on your arrival at the meeting present your certificate to the endorsing officer, Dr. A. C. Christie, Business Manager, as the reduced fare for the return journey will not apply unless you are properly identified as provided for by the certificate.

5. Arrangements have been made for validation of certificates by a Special Agent of the carriers on September 18–21 if the required minimum of 250 certificates is presented.

6. *No refund of fare will be made on account of failure to obtain a proper certificate, nor on account of failure to have the certificate validated.*

7. So as to prevent disappointment, it must be understood that the reduction on the return journey is not guaranteed, but is contingent on an attendance of not less than 250 members of the organization at the meeting and dependent members of their families, holding regularly issued certificates obtained from ticket agents at starting points, showing payment of regular one-way tariff fare of not less than 67 cents on going journey.

8. If the necessary minimum of 250 certificates is presented to the Special Agent as above explained, and your certificate is duly validated, you will be entitled up to and including September 25, 1923, to a return ticket via the same route over which you made the going journey, at one-half of the regular one-way tariff fare from the place of the meeting to the point at which your certificate was issued.

9. Return ticket issued at the reduced fare will not be good on any limited train on which such reduced fare transportation is not honored.

EXHIBIT OF FILMS AND LANTERN SLIDES

The Committee on Scientific Exhibition for the Chicago meeting is desirous that a very large film and lantern slide exhibit be made this year, and hopes that members will send in films or slides of their interesting cases together with complete histories. The space available is such as to make the exhibit this year unusually attractive. The chairman of the committee is Dr. Edw. S. Blaine, 5 So. Wabash Ave., Chicago, Ill. All correspondence concerning the space desired should be directed to him. Films should be shipped direct to the Congress Hotel, marked in care of the Committee on Scientific Exhibition.

Dr. Hickey also requests that as many members as are able should send in films and reports covering bone sarcoma, bone syphilis or Perthes' disease. These should be addressed to the hotel in care of Dr. Hickey.

TRANSLATIONS & ABSTRACTS

RICHARDSON, EDWARD P. Relative value of surgery and roentgen rays in the treatment of hyperthyroidism. *J. Am. M. Assn.*, Mar. 24, 1923, lxxx, 820.

This paper is a combination contribution from the surgical service, the roentgen-ray department and the medical laboratories of the Massachusetts General Hospital. The measures yielding the best results in hyperthyroidism are surgery and irradiation. In the Massachusetts General Hospital, a series of cases of hyperthyroidism treated by the roentgen ray was begun by Holmes in 1914. The results of the treatment were reported by Holmes and Merrill in 1919. From the same clinic, Means and Aub, using the basal metabolism as an index of intoxication in exophthalmic goiter, compared the effect of treatment by roentgen ray with that by surgery. The results obtained in hyperthyroidism by irradiation with the roentgen ray were felt by the committee chosen from the various services to direct the treatment of the thyroid cases, to be sufficiently encouraging to justify a continuation of this form of treatment in selected cases. At the same time the committee believes that roentgen-ray treatment should be limited, as stated by Holmes and Merrill, to cases which show symptoms apparently due to increased function of the gland, such as increased metabolic rate, rapid heart action, nervousness, loss of weight and weakness. Goiters with normal or reduced function, requiring treatment for deformity, pressure on adjacent structures, potential malignancy, or potential hyperthyroidism, should be treated by surgery and not by roentgen rays. The only exception to this is in malignant goiter beyond reasonable hope of benefit from operation. Here the roentgen ray has an important rôle. Beyond this, the roentgen ray is not a treatment for goiter; it is a treatment for hyperthyroidism.

Aside from accurate diagnosis there are certain other essential conditions without which roentgen-ray treatment should not be undertaken. The first is adequate modern roentgen-ray equipment, with ability to measure dosage. The second is means of estimating the degree of benefit obtained by determination of the basal metabolism as well as by clinical observation. Without this, a slight degree of persistent hyperthyroidism demanding further treatment may be continued when there is danger of myxedema. The third is careful and accurate clinical supervision. An open mind should be kept in regard to switching to surgical treatment, if improvement is not rapid and complete. It has not proved possible to predict the effect of the roentgen ray in any given case. Means and Holmes are unable to show that either the age of the patient or the intensity of the hyperthyroidism, as shown by the level of the metabolism, is a factor determining the success or lack of success of roentgen-ray treatment. An impression that recent cases in young persons were more responsive to the treatment was not borne out by their statistical study. There are, however, certain cases in which the roentgen ray seems unsuitable. Among these are adenoma with hyperthyroidism. Here the cause of the symptoms seems to be within the thyroid gland, and not only is it logical to remove this cause surgically, but the late results of operation are better than in exophthalmic goiter. If the roentgen ray is used in these cases, it should be as an adjuvant to the effect of preliminary ligation of the thyroid arteries.

If surgery is more effective in the average case, why should the roentgen ray be used at all? Surgery is a clumsy form of treatment for a gland that is hyperactive. In exophthalmic goiter, the ultimate cause of the disease is unknown. By removing part of the gland we are not affecting the cause; we are merely removing part of a gland that is excited to hyperfunction. The changes accompanying hyperfunction are still present in the part of the gland that remains. The amount of the gland left to maintain thyroid function is purely a guess on the part of the operator. When surgery can safely accomplish removal of a proper proportion of the gland, it has reached its limit. The roentgen ray, on the other hand, while also acting as a destructive physical agent, has nevertheless the possibility of indefinite expansion as a means of treatment. Improvements in technique and manner of application may lead to results as yet unobtained. It shows sufficient promise to be given opportunity. Certain minor advantages have been claimed for roentgen-ray treatment. These are absence of operative scar, sparing the patient the distress and discomfort of going through operative procedures, and the fact that hospitalization may not be necessary. Although these advantages loom large in the minds of patients, hyperthyroidism is a sufficiently serious condition in its immediate and remote effects to make these advantages deserving of slight consideration in advising treatment.

The chief advantage of the roentgen ray is that its immediate mortality is nil. The use of the roentgen ray in the Massachusetts General Hospital is undoubtedly influenced by

the fact that the mortality in the cases of hyperthyroidism treated surgically since the organization of the thyroid committee has been 7.1 per cent. There have been five deaths among 70 patients, in some of whom the surgical program is as yet incomplete. The surgical aspects will be presented later in detail. While the mortality from surgery reported from certain large clinics is small, this would probably not be true of small series and isolated cases compiled throughout the country. The stage of gaining experience in this condition is likely always to result in mortality. It must be remembered that mortality is often figured from the number of operations, not from the number of patients treated, and that figures may combine toxic and nontoxic cases.

It has been said that recommending the roentgen ray has done harm. It is also true that unqualifiedly recommending operation on the diagnosis of exophthalmic goiter may do harm. The roentgen ray will accomplish the "cure" of a certain percentage of cases. In others it will bring about a degree of improvement that will permit of safer operation, or make unnecessary some of the preliminary operative steps. It is an additional weapon in the treatment of hyperthyroidism. The question is how and when to use it.

Many objections have been raised to roentgen-ray treatment. The chief of these is the temporary relief afforded. While it is true that in certain cases there is a tendency for the metabolism to rise after a period within normal limits, these are a small minority. In these, as a rule, roentgen-ray treatment results in a second drop, to the normal metabolic level. On the whole, the results in cases brought to within normal metabolic limits seem satisfactory.

A second objection is the occurrence of myxedema. Means and Holmes report that since the beginning of the roentgen-ray treatment at the Massachusetts General Hospital, 4 patients have developed myxedema. Two developed it within the first four months of roentgen-ray treatment. In both, the depression of metabolism proved temporary. One patient developed myxedema eighteen months after roentgen-ray treatment; another, five years after. Whether in these cases there is any actual connection between the treatment and the myxedema is uncertain. It seems that the danger of myxedema following controlled roentgen-ray treatment is more than balanced by the possibility of recurrent laryngeal nerve injury, particularly bilateral abductor paralysis, or parathyroid injury, following surgery.

Another objection is the increased difficulty of operation following the use of the roentgen ray. The cases coming to operation in the Massachusetts General Hospital after roentgen-ray treatment have been treated there. They have been as a rule exophthalmic cases; if toxic adenomas, the goiter has been small. In these cases there has been no appreciable increase in difficulty of operation. The gland has not been adherent to the anterior muscles. The only change the author has noted has been a somewhat firm consistency to the gland, and possibly a slight increase in fixation posteriorly. The increased operative difficulty has been no more than that after preliminary ligation.

It should be appreciated that there is no less responsibility in advising roentgen-ray treatment than in advising operation. The ill effects of the roentgen ray are more remote, and require more imagination to grasp. If roentgen-ray treatment is advised at all, it should be with the clear understanding that it will be tried for only a few months; that relief is uncertain; that, if improvement is not sufficient at the end of that time, operation must be undertaken. The patient should know that operation will eventually be advisable more often than not.

FONTAINE, BRYCE W. Pulmonary fibrosis. *J. Am. M. Assn.*, Apr. 21, 1923, lxxx, 1129.

The author reports a case of fibrosis of the lung in a woman, aged fifty-two, complaining of blood spitting which had continued off and on for fifteen years. Quantity of blood had varied from a teaspoonful to a cupful. In May, 1918, the patient had symptoms suggesting a pleurisy in the right base; but no cough nor expectoration. Physical signs were those of a moderate-sized effusion in the right chest; but needling gave negative results. Three months later, a roentgenogram showed consolidation at the right base. There has been no cough, sputum or recurrence of fever. Roentgen examination four years later showed the heart and aorta normal, the left lung still entirely normal; but in the right lung, an extension of the fibrosis had involved the entire right side with the exception of the extreme tip above the clavicle. There was a compensatory curve of the thoracic spine toward the affected side. The physical signs and *x*-ray evidence were in striking contrast to the excellent appearance and physical condition of the patient. There was absolute evidence, as shown by *x*-rays, of existence of the process for at least four and a half years. The diagnosis made was "diffuse fibrosis, sclerosis or cirrhosis of the lungs developing as a sequel to pleurisy." The author devotes considerable space to a discussion of the differential findings. On account of the failure of medical measures in this case, roentgen ray

treatment, according to the new deep therapy, was instituted with absolutely no change in the appearance of the lung after one month. However, there has been no bleeding for six weeks and the patient has suffered no ill effect from the treatment.

OSBORNE, SUTHERLAND, SCHOLL, and ROWNTREE. Roentgenography of urinary tract during excretion of sodium iodid. *J. Am. M. Assn.*, Feb. 10, 1923, lxxx, 368.

The authors describe a method by which it is possible to obtain roentgenograms of the urinary tract during the excretion of sodium iodid following its intravenous or oral administration. The method uniformly gives excellent and accurate shadows of the urinary bladder and renders reliable information relative to its size, shape and location. It has been partially successful in depicting the renal pelves and the ureters in a limited number of cases. In a number of cases it assists in revealing the kidney itself through intensifying the renal shadow. It has been proven a success in revealing the existence of residual urine in the bladder and in furnishing approximate information of the amount, thus eliminating the necessity of catheterization and its attendant dangers of infection. Oral administration of the drug will prove satisfactory for routine use in making roentgenograms of the bladder, while for shadows of the ureters and kidneys intravenous injection of large doses of sodium iodid is desirable.

TEES, FREDERICK J. Anterior dislocation at the elbow-joint. *Ann. Surg.*, May, 1923, lxxvii, 612.

The author reports one of the rare cases of anterior dislocation at the elbow-joint. Quoting from Krönlein's series of 400 recent traumatic dislocations, 109, or 27.2 per cent, involved the elbow; and yet if in all the cases of anterior dislocation of this joint thus far reported we exclude those associated with fracture of the olecranon—which, by common consent, should not be regarded primarily as dislocations—the total number does not exceed 20. The author then reports the details of the case, and in his comment remarks that after scrutiny of a series of *x*-ray plates of the elbow-joint in children, such as have been published in a recent article of Cohn on the developing elbow, one is prepared, from the apparent lack of security in attachment of the main lower epiphysis of the humerus, to expect frequent epiphyseal separation as a result of injury; but the relative insignificance of the olecranon is equally striking, which, it might be thought, would render anterior dislocations of common occurrence. Yet but 3 of 13 cases of Stimson's series in which the age is stated occurred in children under fourteen years of age. The explanation of this extreme rarity seems to lie in the strength of the ligaments rather than in the contour of the bones. The ligaments, even in children, must be sufficiently strong to resist a dislocating force from above and behind (such as occurs in falls on the flexed elbow), and ehnce, as a result of this form of trauma, there is ordinarily produced not a dislocation but a separated epiphysis or a supracondylar fracture.

DEMING, CLYDE LEROY. Congenital sarcoma of kidney in a child of twenty-nine days. *J. Am. M. Assn.*, Mar. 31, 1923, lxxx, 903.

The author reports in detail this very interesting case which emphasizes the value of complete cystoscopic examination in children; the fact that urograms are just as essential in the examination of infants as in that of adults; and that local anesthesia may be employed effectively in infants.

ZAAIJER, J. H. Cardiospasm in the aged. *Ann. Surg.*, May, 1923, lxxvii, 615.

Cardiospasm is, as a rule, most frequently encountered in youth or middle age. When, however, elderly people begin to show symptoms of interference with deglutition, apparently due to some narrowing of the esophagus, one is more inclined to consider the condition carcinomatous and without making an exhaustive examination allow these patients to starve gradually, appreciating the fact that radical therapy is of very little effect and that a gastrostomy merely prolongs for a short time a life of suffering. This danger is illustrated in 2 cases which the author cites in detail, one at the age of fifty-eight and the other at the age of sixty-five. He shows that one should be careful not to make a diagnosis of carcinoma of the esophagus, however probable it may be, merely on account of the age of the patient, thus allowing him to suffer unnecessarily from the lack of treatment which would make him entirely comfortable. The first case shows how completely recovery can be obtained in a case of cardiospasm from stomach-tube feeding and the ultimate restoration of the esophagus obtained, as demonstrated roentgenologically. This case apparently negatives the argument that cardiospasm follows a primary megaesophagus. It is the author's custom to consider operative intervention as a last resort.

STEPHENS, RICHMOND. Fracture of the spine of the tibia. *J. Am. M. Assn.*, Mar. 31, 1923, lxxx, 905.

The condition is one of rather extreme rarity and it is difficult to find very much literature

on the subject. Probably the injury occurs more frequently than the records would indicate, however. This injury is due to a severe traumatism, usually of the twisting variety. Rupture of the crucial ligaments is a frequently associated lesion, and is probably due to pull by these ligaments. Diagnosis is difficult without the roentgen ray. Conservative treatment is usually successful in recent cases, and occasionally in old cases. In old cases particularly with blocking of extension, operation is indicated. Operation through a split-patella incision is the best, and removal of the offending fragments is very easy. The final results are excellent in all cases; for, if the conservative treatment does not give a perfect recovery, operation will accomplish this end.

NUTTALL, H. C. WARDLEWORTH. Tuberculosis of the sacroiliac joint. *Lancet*, Apr. 28, 1923, cciv, 839.

After discussing the anatomy, pathology, symptoms and signs the author devotes sections to diagnosis, prognosis and treatment. Under diagnosis he states that in the early stage before abscess formation the most reliable sign is the presence of tenderness on direct pressure over the joint. Patients frequently complain of pain over the joint in sciatic neuritis or other conditions, but as a rule true tenderness is absent. In discussing the pathology, it has been seen that the infection is primarily in the bone, and one would expect that a roentgenogram would show some change in the shadow. This must depend on destructive bone changes, which probably take one or two months to develop. Roentgen examination, therefore, is a valuable confirmatory test, and should be repeated after an interval in a suspected case. The other symptoms and signs are commonly present in other diseases and appear more likely to mislead than to aid in diagnosis. In the later stage after the formation of an abscess, the presence of a fluctuating swelling, together with the tenderness over the joint, and the *x*-ray appearance, renders the diagnosis a simpler matter. The abscess may point, however, at a considerable distance from the joint.

In the differential diagnosis the acute infections (pyogenic or gonorrheal), osteoarthritis and sprain are the most important. The chief distinguishing characters are the acute onset, pyrexia and more rapid course of the infective conditions, the likelihood of other joints being affected, the history, and the *x*-ray appearances. Clinically it is impossible to distinguish between early tuberculosis and sacroiliac sprain or relaxation, but the latter speedily recovers with rest and strapping of the pelvis; the roentgenogram is negative.

Another difficulty in differentiation concerns affections of the neighboring bones and joints such as tuberculosis of the hip or spine, scoliosis, chronic sprain of the back, sarcoma of the ilium or the sacrum; and malformation of the fifth lumbar transverse process may be excluded by careful examination and the roentgenographic appearances. For instance, in hip disease limitation of movement is quite definite in all directions; in sacroiliac disease gentle examination shows that movement at the hip-joint is painless in one or other direction. The same remark applies to the spine. A roentgenogram will show growths of the bones or periostitis of the fifth lumbar transverse process in cases where it impinges on the crest of the ilium. Further differentiation may be required between affections of nerves including true sciatic neuritis and other affections such as growths in the pelvis, ovarian or uterine disease or appendicitis.

BEARSE, CARL. Osteomyelitis of the ilium in children. *J. Am. M. Assn.*, Apr. 7, 1923, lxxx, 991.

When osteomyelitis of the ilium occurs in children, it is a particularly serious condition, because the diagnosis at first may be difficult. Since immediate prognosis, prevention of complications and shortening of convalescence depend on early treatment, early diagnosis is essential. This condition should always be borne in mind in a case of painful hip that permits motion. The local symptoms are often referred to the hip-joint, and not to the ilium. The important factor in diagnosis is tenderness over the ilium, without restriction of motion at the hip-joint. The roentgen ray is at first of no help, but later of decided aid. The author cites 4 cases.

SUMMERS, JOHN E. Transposition of viscera (situs viscerum transversus). Report of a case without transposition of the usual abdominal reflex. *Nebraska M. J.*, Apr., 1923, viii, 117.

The author reports another case of transposition of the viscera in which there was no transposition of the usual abdominal reflex. No attempt is made to review the literature, the author citing the exhaustive article of James Rae Arneil which appeared in the *American Journal of Medical Sciences*, 1902, p. 885, as being the most exhaustive article on the subject which he could find. The author rehearses 4 cases which were described to him from the Mayo Clinic and adds a 5th case.

KRIDA, ARTHUR. Secondary os calcis. *J. Am. M. Assn.*, Mar. 17, 1923, lxxx, 752.

The author reports what he believes to be the first case in the literature where a secondary os calcis was implicated in a traumatism of the foot. He cites the work of Dwight as offering the most comprehensive information in American literature on the subject of accessory bones of the foot. In the great number of dissections that Dwight made, he apparently found only two examples of a separate bone in this situation. From the clinical standpoint, the separate ossicle described by Pfitzner may be accepted as the typical secondary os calcis. Its occurrence in 2 per cent of his large series of dissections need not lead to the expectation of finding it frequently in routine roentgenograms of the foot, as the smaller and less well-developed specimens might easily escape demonstration. It would seem that a well-developed secondary os calcis, acting like a wedge in a series of complicated movements in the middle of the tarsus, would be peculiarly liable to avulsion or displacement.

HESS, ALFRED F., and WEINSTOCK, MILDRED. A study of light waves in their relation to rickets. *J. Am. M. Assn.* Mar. 10, 1923, lxxx, 687.

The authors undertook a series of experiments which seem to indicate that in order to be of value in rickets, ultraviolet waves must have a wave-length not longer than 302 or possibly 313 millimicrons. This renders light that has passed through ordinary window glass of no therapeutic value in this disorder. The shortest waves of sunlight that reach the surface of the earth are about 290 millimicrons, and vary greatly in intensity according to the time of the day and the season of the year. Indeed, when the atmosphere is heavy with moisture, smoke or dust, the shortest of these waves are absorbed. It is evident, therefore, that the range of effective radiations is markedly circumscribed by nature, and further limited by meteorologic conditions. The foregoing experiments serve to emphasize the remarkable specificity of wave-lengths of light in relation to rickets. It can be stated with confidence that waves 324 millimicrons in length have little or no value in protecting against rickets, and that waves of 302 millimicrons are of great value in this respect. This signifies that a difference of about thirty millionths of a millimeter in wave-length suffices to render ultraviolet light effective or ineffective. The experiments with clothing material indicate that the rays do not have to impinge directly on the surface of the skin. Clothing must be regarded as other filters which screen the effective rays, namely, according to their texture or thickness. Furthermore, a direct quantitative relationship exists between the nature of the material and the duration of exposure to sun's rays or artificial sources of light. Black clothing will absorb more of the effective ultraviolet rays than similar white material.

The spectrum would seem to contain not only rays which can prevent or cure rickets, but also longer rays which are able to neutralize or inhibit the effect of these beneficent radiations. This phenomenon points to the need and the value of an analysis of rays employed in heliotherapy in rickets, tuberculosis, and other diseases. It would seem to indicate that this valuable therapeutic agent will be used with the employment of filters to absorb radiations which may be not only ineffective but counteracting.

JAPIOT. Contribution to the radiographic study of the causes of lumbar arthritis. *Lyon méd.*, 1921, cxxx, 1090.

Lumbar arthritis, the lumbar localization of ossifying spondylosis, with lateral exostoses in the shape of beaks and hooks, is at present considered very unusual. Japiot has himself found 20 cases of it.

It is generally admitted that the cause is rheumatic; but it seems to him, from his observations, that it frequently has a different origin.

1. It can be traumatic. The author published in the same magazine a report of a very characteristic case resulting from a vertebral compaction. Since then he has seen 2 more cases. Finally, Professor E. Martin has collected a remarkable specimen from a man long ago traumatized; the characteristic exostoses exist in a ladder formation along a large portion of the spine, and clinical observation leaves no doubt as to the relation between these deformations and the accident.

2. It can be tuberculous. In support of this opinion Japiot presents:

Two specimens from De Gallois' collection permitting a comparison between rheumatic spondylosis and that connected with Pott's disease.

A series of photographs sometimes only allowing tuberculosis to be suspected (compaction and disappearance of a vertebral body) and confirming it twice (abscess by congestion).

How can the real cause of lumbar arthritis be recognized? Evidently clinically more than otherwise. It seems to him, in addition, that the close localization of the process upon the body favors a non-rheumatic cause.

One can easily see the importance of these

facts from a diagnostic point of view in judging industrial accidents (traumatic spondylosis), and from the therapeutic point of view (immobilization of tuberculous spondyloses).

KELLY, HOWARD A. Radium therapy, with special reference to diseases of the female pelvis: A rejoinder. *Therap. Gaz.*, Nov. 15, 1922, xlvi, 761.

Dr. John B. Deaver, in the *Therapeutic Gazette* of July 15, 1922, published an article which was conspicuously anti-radium. This article by Dr. Kelly is a rejoinder. He does not hesitate to state that Deaver writes on a subject about which he appears to know little and that little evidently from hearsay. Deaver's article, however, serves to exhibit the confusion of the average general professional mind on this "comparatively new, very special, most promising, and tremendously aggressive form of therapy."

At the very outset Kelly submits that: "It is unfair and destructive to the eager expectation of our sorely afflicted humanity, ever straining its eyes toward the horizon in hopes of relief from some of the diseases with which it is afflicted, to write such a deprecatory article on so valuable, well-known and already well-tried an agent as radium. It is likewise an unpardonable omission not to mention with a heart overflowing with thankfulness the unparalleled blessings which have already come to so many thousand sufferers through this agent in a great variety of fields. I refer here to the lympho- and angiosarcomas of the nasopharynx and of the whole body, to Hodgkin's disease, to the leukemias, to mediastinal tumors, to many brain tumors, to the primary testicular carcinomas, to the sarcomas of the ovary in children, and many other ailments. There ought to be at least a glimmering sense of gratitude that radiation can bring about painless and bloodless cures in ailments in which true surgery has never even dreamed of making an effort—and that, too, radium cures are lasting already for years.

"Were it not for personal attachment and for the high esteem in which we all hold Deaver as one of our keenest cutters and most doughty wielders of the scalpel, I would dismiss his strictures upon radium with the citation of an old college skit on Bishop Berkeley, the idealist, which ran, 'When Bishop Berkeley said there was no matter, it was no matter what Bishop Berkeley said.' But inasmuch as I profess to be a cosmothetic idealist, I will try to undo some of the harm Deaver's misleading and injudicious article may have wrought.

"Let us pass in silence his reference to the 'biologic effect of radium' and the 'law of Bergonié and Tribondeau,' to which he adverts after the gingerly fashion of one who craves credit for erudition, but who is conscious of treading boggy ground."

"We all heartily concur with Deaver in urging a continuance of the campaign to bring patients to treatment in the early stages of cancer, and, where possible, to remove the causes of irritation, the forerunners of certain cancers. It should be remembered, however, in the fight against cancer, that our means of knowing the early stages are limited except in a few well-defined localities. Even if a diagnosis could be made, how many cancers of the brain, cancers of the lung, cancers of the pancreas and so forth could be cured by operation? One might say, therefore, that the broad statement that in the early stage cancer is local, amenable to treatment, and almost certain of cure, is somewhat of a surgical illusion."

Kelly confines his discussion to the four gynecological conditions mentioned by Deaver in the article above referred to, namely: (1) Fibroid tumor of the uterus. 2. Hemorrhagic uterus. 3. Cancer of the body of the uterus. 4. Cancer of the cervix.

In regard to *fibroid tumors of the uterus*, Kelly pronounces this dictum: "He who would give his patient the same consideration he would give to his wife or his sister, must put radium first in the treatment of fibroid tumors." The fibroids calling for treatment are those which are growing, those which are bleeding, those which disturb function or cause pain by pressure on neighboring organs, and those whose nature is in doubt. In the last group we include those in which a clear diagnosis is not possible. If there is anything suspicious about the tumor, in the rapidity of its growth and its softness, or any suspicion of an ovarian tumor complicating it, or lateral inflammatory disease, then operation is the choice. Every patient with a uterine fibroid with bleeding or discharge should be subjected to a preliminary dilation and curettement as a routine procedure. In the uncomplicated fibroids, especially when associated with excessive bleeding, there is no treatment as satisfactory as radium. Kelly asserts that even in the large tumors a large percentage show either complete disappearance or a marked reduction in size. Of course, calcified, cystic fibroids and occasionally other forms do not respond by decrease in size.

In younger women, Kelly advocates myomectomy, although he has been able in a number of cases to shrink fibroids by irradiation without disturbing the patient's menstrual function for more than a few months or at the most for a year or two. Radiated fibroids often

disappear completely, but even if the fibroid only shrinks and causes no more trouble the result is satisfactory, inasmuch as some 20 per cent of all women have just such small fibroids, and many never even know it. "It is blessed foolishness to declare that a mutilating surgical operation, which removes the womb just for the sake of getting out some fibroid tumors encapsulated in it, is a satisfactory operation, while to stop the growth of the tumor and shrink it with radium is unsatisfactory."

The hemorrhagic uterus. This condition was often mistaken for cancer of the uterus and the removal of one of these uteri was often a source of humiliation to the surgeon. Radium, however, comes to our aid by the simple expedient of inserting a tube of radium into such a bleeding uterus, say 100 mgm. or its equivalent, for fifteen hours—presto! the hemorrhages disappear and the patient is cured. This is so far the greatest triumph in surgery since this century began. If radium did nothing else but bring relief to this one group and eliminate surgery, it would be worth all the investments of all the clinics in the country.

Fundus cancer. Kelly believes that here surgery is the method of choice; but he is thankful, in the cases where surgery is not applicable, to be able to use radium with so much success and the hope of a prolonged and remarkable improvement.

Kelly's remarks concerning cure are worth considering. He says: "Let us sometimes with the patient's peace of mind in view, use the word 'cure' in a modified sense. 'Palliation' is relief, more or less complete, of distressing symptoms, while the disease obviously remains, to advance at a later date. When shall we use the word 'cure' in reference to an apparently effective cancer operation or treatment? If we demand certainty, then we can never say a patient is cured, for the five or even ten year limit is purely arbitrary and not decisive. Why not then say 'cure' when after the first year there are no discoverable signs of disease, being aware that there will be a certain percentage of relapses? I urge this in the interest of the patient, who can then for a time forget the sword of Damocles. I commonly say to the patient, 'As far as I can see you are perfectly well, and I am expecting you to remain well; now go about your business, but report to me every five or six months, for several years.' Let us not be so ultrascientific as to forget the patient's point of view."

Cancer of the Cervix. We again quote the author. "This is manifestly Deaver's crux, and here he falls into as distressing error in comparing operative with radium cures. Let me ventilate his confused logic and false conclusions by transferring the comparison to another field. Suppose I had declared some years ago that I now had a new and successful method of treating all breast cancers, of whatever nature and however advanced, and that I received and treated all cases indiscriminately as they came to me, and I was then able to report a 20-per-cent five-to-seven-year cure. Then along comes a zealous disciple of the knife, who has operated only upon selected cases which showed no axillary involvement or distribution beyond the freely movable breast, rushing into the arena, crying, 'Hey, I have far better results, I have saved 25 per cent by operation. Away with your new remedy!' Where, I ask, is the sense of comparing such utterly dissimilar groups except to declare at once, 'How far superior is the method which deals so successfully even with the advanced hitherto hopeless cases?'"

Here Kelly quotes from a letter written him by John G. Clark July 18, 1922, as follows: "Of the large number of cases which we have treated for the last year or two practically none were operable, and because of the astounding good result in some of the apparently hopeless instances, we have very materially decreased the number of our operations in cancer of the cervix. Indeed, we scarcely operate any more in the latter cases. I have always tried to emphasize as strongly as possible the fact that if we can get a 20 per cent three-year salvage in the hopeless cases we ought to do better than 33 per cent in the operable cases of very limited growths, hitherto submitted to a very extensive panhysterectomy."

The author then goes on to divide cancer of the cervix into three classes:

1. With extensive lateral involvement and fixation.

2. Where the lateral infiltration is moderate and where neither side is fixed.

3. Where the disease appears limited to the cervix and mobility is not interfered with.

A rectal examination is imperative and decisive as to extent in nearly all cases. In the first group operation is worse than futile; radium often, however, gives great relief in checking hemorrhages and discharges and relieving pain. Occasionally one gets a cure here if enough radium is judiciously used. Group 2, with evident lateral involvement, is a group where the surgeon's hands ought to be tied. Here again radium palliates without the risk of operation. In Group 3 it is quite certain that radium gives a high percentage of permanent cures, almost certainly higher than operation alone, and without its attendant mortality and

morbidity. In those early cases in which the general condition of the patient is good, a combination of operation and radium is for the present highly to be recommended, that we may know whether the combination gives us the best frontal attack on our dread enemy. Such a combined treatment may well be better than either radium or surgery alone. It also makes possible the implantation of radium points into any discovered glandular metastases. Where pre-operative radiation is given, the operation should be done in the first three or four days after radiation. A longer period of delay leads to sclerosis of the parts and makes the operation much more difficult.

Kelly concludes: "I have no quarrel with the man who goes on operating for the present on these properly selected cases of cancer of the cervix, for we who are engaged in a new work, exploiting fresh fields, have no right to expect the entire profession, busy about so many things, to catch our vision at once. But I do have a gravamen of complaint against any one who would hinder our work, rob our patients of their hope, and some of their lives, and, by disseminating doubts, and by innuendo, obstruct our path. I also inveigh against him who operates on Groups 1 and 2, which are so obviously unfit.

"When my friend declares that radium is a failure in the face of these overwhelming experiences, I reply in the words of Priscilla of old, 'Speak for yourself, John!'"

REICHOLD, ALBERT. The effect of roentgen rays on the mitotic cells in carcinomatous tissues and on the blood-vessels. *Münchcn. med. Wchnschr.*, July 15, 1921, lxviii, 881.

Important results were expected some time ago from the roentgenization of malignant growths, but these expectations have not been realized. Despite improvements of the technique and the variety of the radioactive substances a great majority of the tumors do not react to roentgenization. The author has examined the effect of roentgen rays of the mitotic cells obtained from carcinomas. Five cases of cancroid of the lip were thus examined, which were radiated after intervals of a few days with between 10X and 20X through an aluminum filter 3 mm. thick. After each roentgenization small portions of tissue were excised for examination. It is very important that these specimens should be placed in 10 per cent solution of formalin, as changes may otherwise occur in the extirpated tissues. The specimens were stained with sulphate of iron and ammonia and with hematoxylin. The carcinomas disappeared as a result of the roentgenization. The histologic examinations showed in all these 5 cases, rich mitotic cell formations, which the author believes to have caused the disappearance of the carcinomas after roentgenization. In sections the size of 1 sq. mm., from 10 to 15 mitotic cells were found. Soon after the second and third roentgenization a noticeable karyokinesis could be observed, and the diaster forms had disappeared totally. In specimens which had been irradiated with 100X, all tumor cells were found, after four days, to show symptoms of degeneration. The changes in the blood-vessels in these irradiated preparations were also very interesting. After irradiation with a dose of 100X, the vascular tissues had the aspect of cavernous tissues. The intima cells changed their forms and became cubic. In later preparations manifold compact cell-syncytia from intima cells were found.

On the basis of these observations the author believes that the mitotic cells are the parts of the carcinoma most sensitive to roentgen rays, and that an enormous increase of the vessels occurs after roentgenization, this apparently taking an active part in the cure of the carcinoma.

PARRISIUS, W. Warning against overdosing with *x*-rays in cases of myelomatous leukemia. *Strahlentherapie*, Feb. 15, 1921, xii, 234.

The undoubtedly good results obtained from roentgenotherapy carefully administered in leukemia may easily be counteracted by too long continuance or by too severe a dosage. Four cases are cited in which ill effects were attributed to these causes. In all, the threatening condition improved, but following the treatment there were: rapid loss of strength, attacks of cardiac insufficiency, rapid destruction of leukocytes, and shrinking of the spleen. Such disasters are obviated completely by the author's technique. He treats the patient eight times in twelve weeks, using a 6 by 8 cm. field, 23 cm. focal distance, a ½ mm. zinc filter, plus a 1 cm. of aluminum, the duration being six minutes. The last sittings may be lengthened to eight and ten minutes. This represents one-sixth, later one-quarter to one-third of the erythema dose. Every second day a blood examination is made, to determine whether the leukocyte count has fallen and the patient therefore has become ready for another treatment.